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Explored were the relation of changes in personality to changes in achievement over a one-year period, the relationship of personality and motivation, and measures of intrafamial attitudes in objective tests as bases for discovering the predictive power of family attitudes with regard to the child's school performance.

Children were studied from seventh through ninth grades and from eighth through ninth grades. Successive annual cross sectional studies were conducted that permitted static, absolute, and developmental analyses. The children were tested on school achievement, intelligence, personality factors, motivational level, and family attitudes. The first analysis, predicting personality and motivation factors, confirmed findings of earlier studies on the importance of self-sentiment and superego development in long term goal striving and on the interrupting effect of dissatisfied sensual and other drives. A second analysis, evaluating the normal degree of fluctuation and change in traits and performances over a year period, found rises in intelligence, superego strength, parmia, and self-sentiment. More fluctuation was found in personality traits than in abilities and aptitudes. Specific connections were found between achievement and such traits as superego strength, self-sentiment strength, sex-erg-tension, and narcissism.

Hypotheses suggested for further study were: that by 14 or 15 years of age the correlation between intelligence and achievement increment becomes trivial, and the individual differences in personality and motivation assume the major role in determining achievement increments; and that achievement increments from year to year are strongly determined by motivation factor levels relative to ability and personality measures.

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THE GENERAL RELATIONS OF CHANGES IN PERSONALITY AND INTEREST TO CHANGES IN SCHOOL PERFORMANCE: AN EXPLORATORY STUDY

Co-operative Research Project Number 1411

BY RAYMOND B. CATTELL
and
A. PHILIP SEALY

With the assistance of Professor Arthur B. Sweney,
Texas Technical College

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Laboratory of Personality Assessment and Group Behavior;
Department of Psychology,
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THE GENERAL RELATIONS OF CHANGES IN PERSONALITY AND INTEREST TO CHANGES IN SCHOOL PERFORMANCE:

AN EXPLORATORY STUDY

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Preface

This is the second of two related investigations supported by the Cooperative Research Program Project of the Office of Education.

The first raised the question of how far the prediction and understanding of school achievement could be improved by adding personality and motivation measures to the ability tests already in use. The investigators were interested in raising this practical question only in so far as an answer would be also of theoretical and permanent value through being expressed in terms of personality and motivation structures found by basic research, rather than some artibrary set of tests. Although there were inevitably certain measures which failed of reliability in so broad an attack on this new field, the results showed that the inclusion of fourteen of the major personality factors, and about the same number of the recently located dynamic structures just about doubled the amount of the criterion previously predicted from ability tests ("mental tests") alone.

Accordingly we proposed next in the present research to check the "static" prediction on a fresh sample, and to ask further (a) How do these newly measured personality and motivation factors change in a trend or by instability with time, and (b) How far can changes in school performance be related to changes in personality and motivation.

Again, we were more concerned to have meaningful personality measures, in the High School Personality Questionnaire, and meaningful dynamic structure in the preliminary Motivation Analysis Test, than to seek immediate high reliabilities. If we have the true, naturally occurring structures, time will ensure that better tests be developed for them. Thus, although both studies have the defects and approximations of exploratory researches, they avoid the pointlessness of those exploratory researches which deal with concepts and measures never to be found again. Through unavoidably rough scales and low reliabilities our results may be blurred relative to what can next be done; but they represent a reality somewhat out of focus rather than an artificiality. It is clear now where solid predictive possibilities are to be found and what kind of instruments need to be developed.

The testing for these studies demanded a considerable amount of school time, as well as repeated visits and checks over two or three years. We wish to thank profoundly those school superintendents, principals and classroom teachers who had the vision to perceive the uncommon goals at which we aimed, and the patience to bear with the inconveniences. In particular we want to express our gratitude to Superintendent Virgil Judge of Mattoon, to Principal Hungerford, to Principal Ronald Vogich of Gilman School, Westview Junior High near Danville, and to Dr. R. J. Williams, the School Psychologist of Kankakee, all in the State of Illinois.

It is to be hoped that readers will forgive certain omissions in minor tables due to the fact that immediately on the conclusion of this research one author had to go to New Zealand and the other to his position in London, thus creating some communication difficulties in preparing the final report on schedule.

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Chapter 1

Research on New Possibilities
In Predicting School Performance

1. Present Status of Research Measurement of Necessary Personality, Motivation and Attitude Predictors In School Predictions

The present study deals with a matter of interest to every teacher; but its conclusions must necessarily be tentative, for two reasons: (1) It breaks into an area of measurement never previously attempted and, like any pioneer study, needs at least one confirmatory check before its conclusions can be accepted, and (2) The necessary concepts in the field of predictors, such as the existence of particular ergic structures, the measurement of family attitudes as vectors, by objective motivation measures, etc., themselves needed consolidation before we could press on to the designated goals of the research.

As to these necessary concepts, a brief recapitulation of the last decade of research is desirable in order that the scientific questions which this research asks can be clearly understood. Our concern is broadly with the relation of personality and motivation to school achievement, and requires prior reference, therefore, to (a) personality concepts and (b) motivation concepts.

Personality measurement has progressed over the past decade principally through the increasingly exact determination of structure by factor analysis, applied to ratings, questionnaires and objective tests. Our approach has been through the questionnaire medium in which strategically organized research across different age levels (Cattell and Coan, 1958; Cattell and Peterson, 1959) and across cultures (Cattell, Pichot and Rennes, 1961; Cattell and Tsujioka, 1965) have established some fourteen factors, as (1) existing developmentally up and down the age range and (2) of stable importance across cultures. These factors have letter symbols, and names which are partly technical and partly for popular use, such as A, cyclothymia-vs-sizothymia; B, intelligence; C, ego strength; D, excitability; E, dominance; F, surgency-vs-desurgency, and so on. Fortunately for current research these factors have recently become represented in the HSPQ (High School Personality Questionnaire), the scales in which have been standardized by IPAT, and have had their psychometric properties--which are adequate--recorded.

Dynamic, motivation measurement, on the other hand, stands at a lower level of validity and reliability. The demonstration by Cattell and Baggaley (1956) that verbal, preference methods of attitude and interest measurement--so widely depended upon--are of low validity and evaluate "only the visible part of the total iceberg", has been accompanied by systematic efforts to develop new objective measures (Cattell and Baggaley, 1956; Cattell and Horn, 1964; Cattell, Radcliffe and Sweney, 1963). As a result the structure, in terms of seven primary and two second-order factors, among some ninety objective test devices, is now known. However, the concept (construct) validity of available devices is not yet high and their reliability in test lengths practicable in school is not yet what one would like.

Using the new objective measurement devices it has nevertheless been possible to map out the dynamic structure of the typical child in our culture by comprehensive factor analyses of the personality sphere of interests. The upshot of dovetailing several such mapping researches has been the demonstration of some nine drive structures or ergs--fear, self-assertion, gregariousness, sex, etc.--and some half dozen sentiments--to home, to religion, to hobbies, etc. Each of the latter appears as a set of substantially intercorrelating attitudes in a factor which is presumably the result of a pattern of reinforcement of a special subset of attitudes within a single social institution (Cattell & Horn, 1963).

At the adult level an actual test, the MAT (Motivation Analysis Test) measuring ten dynamic structures in one hour, by four devices giving I, integrated, and U, unintegrated, motivation components in each, has recently been published. But at the child level the validities achieved experimentally have not reached a level at which a publisher would be interested in the labor and cost of standardization. Nevertheless, as a service to research one publisher--the Institute for Personality and Ability Testing--has put together the best available items and devices for younger high school children into a usable, conveniently scorable experimental form and it is this unpublished instrument (called PMT, for Proto Motivation Test) which we shall employ to measure ergic tension levels and sentiment development levels in some 15 factors, as described below. A cruder forerunner of the same device was used in the first attempt to predict school achievement by objective motivation measures (Cattell, Butcher, Connor, Sweney and Tsujioka, 1961) and the results showed that despite its crudity, a significant increase in prediction of school achievement could be obtained beyond that due to ability and personality trait predictors alone.

In the third field from which we hoped to draw predictive power--that of the child's family setting--the prospects of satisfactory basic research instruments are positively bleak. Indeed, if objective tests are aimed at, absolutely nothing exists. From the theoretical and experimental standpoint it would seem possible, however, to use the same techniques as have been developed in MAT and the PMT to measure a child's attitude to a parent (and vice versa) as a vector quantity, simultaneously defining its ergic (emotional) quality and strength. But both the proof of this possibility and the production of sufficiently valid scales needs to be undertaken from the ground up. As this report shows, we made progress toward objective family attitude measures, but not to the point of moving into practical prediction by this means.

2. State of Knowledge on Achievement Prediction

Volumes have been published on prediction of achievement from abilities. An appreciable number of articles has been published on prediction from personality. But except in the case of those of which we take cognizance, the personality measurements have been almost entirely by ad hoc arbitrary scales having no relation to personality structure and hence not readily incorporated in general personality theory.

The first study using well known personality source traits--well replicated in ratings and questionnaire measures--would seem to be that of Butcher, Connor, Sweney, Tsujioka and the present writer (1961), which reached the specification equation,

$$\text{Achievement (General)} = .05A + .34B + .01C + .07D - .34E - .09F + .07G - .14H - .08I - .13J - .10O - .12Q_2 + .20Q_3 + .02Q_4$$

where the letters indicate, by the usual symbolism, the factors in the HSPQ and the coefficients are beta weights, not correlations. This has been checked in unpublished work in our laboratory on other groups. Such research has confirmed the general pattern but shows the truer weights to be higher and suggests that circumstances in some way attenuated the above coefficients. Thus, typically, B, intelligence, has a weight of 0.5, C of 0.2, G of 0.4 and Q_3 of 0.3.

The pattern has also been investigated in special groups, e.g., by Pierson et al (1964) with delinquents, who found the achievement specification equation to be:

$$\text{Achievement} = .28A + .61B + .22D + .32G + .39I + .16Q_2 + .34Q_3 + .24Q_4$$

For college students, Holmes (1962) found the weights:

$$\text{Success in General College Curriculum} = -.2A + .6B + .3C - .2F + .2G + .1I - .2L - .2M - .1O + .1Q_1 + .4Q_3 - .2Q_4$$

In teacher training colleges, Warburton and Hadley (independently) reached a weighting averaging as follows:

$$\text{Achievement} = -.1A + .5B + .1C - .3E - .4F + .4G + .1I - .2L - .2M - .2N + .3Q_3 - .2Q_4$$

Other special group results are now available. Without going into these in detail we may summarize the consistent outcome for personality theory and practical prediction as follows: in most school learning situations and across all ages the following stable relations show:

Achievement is significantly positively related to:

B	Intelligence
C	Ego Strength
G	Super Ego Strength
Q_3	Self Sentiment Development

and negatively related to:

E	Dominance
F	Surgency
L	Protension
O	Guilt Proneness

By contrast to these comparatively well converging findings in personality, in the field of motivation only our pioneer results (Cattell, Connor, et al, 1961) yet exist, giving the following weights:

Achievement = .18 Super Ego (dynamic measures)
.09 Self Sentiment (Dynamic measures)
-.15 Exploratory Erg
.58 Submissiveness
-.11 Assertiveness
.15 Religious Sentiment Strength
-.09 Narcism
-.27 Constructiveness

In passing it may be pointed out: (a) that the dynamic, objective motivation measures agree with the questionnaire measures of the same factors in showing achievement positively related to super ego and self sentiment strength, and (b) that from an educational philosopher's point of view there are some disturbing findings here, suggesting that a lively, wide ranging curiosity, and constructiveness (need for creativity) become in our school system negatively related to examination achievement and that submissiveness and docility rather than independence of mind favor good grades.

It is noticeable that the correlations and weights for the dynamic structure factors are in general smaller than for personality factors, though the presence of some large correlations, e.g., for submissiveness, suggests that with more reliable and valid instruments, i.e., with correction for attenuation, substantial connections remain to be found in this dynamic area. The final estimates made (Cattell, Connor, et al, 1961) for the relative contribution to achievement from the three main modalities, when tests are corrected as far as possible at present for attenuation is:

Modality	Fraction of Achievement Variance Predicted
Ability Dimension Measures	$\frac{1}{4}$ th
Personality Dimension Measures	$\frac{1}{4}$ th
Dynamic Dimension Measures	1/6 th
Total	2/3 rds

It should be pointed out that evidence is adequate that the three kinds of tests are truly tapping distinct "factor spaces", i.e., with the two exceptions of cross identification mentioned above they are not testing the same things in a different way. Consequently, they contribute largely independent evidence to the criterion and approach a multiple R of 0.8 (equivalent roughly to 2/3rd variance accounted for, as given above).

If this value can be sustained in cross validation we are achieving considerable control. For it is perhaps scarcely to be expected that characteristics within the child himself should account for more than

2/3rds of the variance. One must remember that circumstances in the home, accidents of illness at testing time, classroom atmospheres, etc.--not to mention the specificity and unreliability in the achievement criterion itself--might very easily account for the missing one-third of the variance. Conceivably, therefore, by using factored, structured tests spanning comprehensively the chief dimensions of the three modalities, we are already, with some attention to lengthened tests and reliability, far on the way to predicting all that can be predicted from the characteristics in the child himself.

3. Questions in the Present Research

The research question which next naturally arises is "In which direction does the kind of causal influence which is indicated by these correlations actually operate?" It is easy to make hypotheses in either direction, or, indeed, to suppose that influence takes place simultaneously in both. For example, high guilt proneness (O factor) might be a consequence of poor school performance, for success and failure in school loom large in the happiness of the typical child in our school culture. But a low self sentiment development could equally be the cause of poor achievement, in so far as the individual has little self respect and "does not give a damn", or it could be the consequence of poor achievement, when the self sentiment of the totally discouraged person collapses under the prolonged situation. On the other hand, it is difficult to see in the case of dominance (E factor) and surgency (F factor) how failure could heighten these and the almost inevitable conclusion here is that a high endowment in independence, or in the light-hearted, happy-go-lucky characteristics of surgency, detract from assiduous efforts to please the teacher.

Such a priori argument is, of course, not enough, and one must, to establish causal connections, observe sequences of change. We know that this is possible, because achievement changes from year to year and personality measures also change. Consequently, by measuring the changes, and their sequences, on both sides of the correlation, it should in principle be possible experimentally to determine which causes which. Our present research attempted to throw initial light on this causality by introducing sequential measurement.

The point that personality changes deserves comment. Psychometrists are so accustomed to thinking of I.Q.'s, aptitudes, etc., as essentially fixed characteristics, that they forget that significant "function fluctuation" and changes are more characteristic of personality and motivation, and, what is more, that well conceived and constructed tests, as in certain 16 P.F. studies in the clinical field have recently shown, are sensitive enough to reveal this. Consequently the above question is open to experimental investigation.

With these facilities, anyone interested in the increasingly socially important, and nationally vital question of fostering effective school progress--by understanding the effects of children's personal characteristics and background, as distinct from studying classroom method--is faced with an embarrassing number of opportunities. For anyone in our area of research there are at this juncture apparently the main alternatives of (a) seeking to consolidate the recently gained knowledge about the increase of "static" prediction from adding personality and motivation measures to ability measures, and (b) proceeding to investigate the new areas relating change in personality to change in achievement.

In so new a field some consolidation and replication is obviously called for, since we do not claim that the above static values are precise, and we have not explored the range of variation for different samples and types of school. On the other hand, granted the above demonstrations of the rewardingness of this approach, many other investigators could pursue these relations, perhaps with better facilities and settings than our own, whereas the second topic calls for designs and forms of measurement which can only be developed by specialists in this psychological measurement field. In the end we decided upon a compromise which, in attempting to press on to the new issues, would contribute, even in the event of these new solutions proving beyond our present grasp, to consolidation of knowledge about direct static correlations of achievement with personality and motivation. As to the new area itself, even though our results should not be unambiguous, at least we could hope to clear up methodological difficulties in a way to permit more exact substantive conclusions later.

Thus the hypotheses which we set out to investigate could be briefly summarized as:

(1) That the structure of interests as measured by objective test devices is as previously concluded in the pioneer research above, i.e., a specified set of ergs and of sentiments. This is a "checking" problem.

(2) That these dynamic structure factors are substantially independent of the personality and ability factors and that their addition to the latter produces an improved prediction of achievement.

(3) That the correlations of personality factors with school achievement are of the direction and order specified above.

Beyond this testing of specific hypotheses we aimed to explore the relations of changes in personality over one year to changes in achievement, and to develop measures of intrafamilial attitudes in the medium of objective tests, as a basis for discovering the predictive power of family attitudes in regard to the child's school performance.

Chapter 2

Design of the Experiment and the Measurements

1. Some Special Problems

The first framework of the design of an experiment such as this, as well as the techniques of procedure, are relatively straightforward and well tried. Indeed, we are simply repeating the main design of one of the researches which forms the foundation for the present one (Cattell, Butcher, Connor, Sweney and Tsujioka, 1961). But entirely new methodological problems are encountered in the measurement of change and in the development of measurement for family attitudes and atmospheres.

As to change measurement, the technical problems have been much neglected despite the popularity in psychological textbook titles of the term "dynamic" used in the sense simply of "change". Lip service is frequently paid to these dynamical process aspects of behavior but apparently few researchers have been willing to risk the statistical dangers and complications awaiting them in this pioneer area. In the ability and personality modalities we know that traits have an appreciable stability, but little is known about the interest and dynamic structure area, beyond the general clinical impression that its structures are more subject to change than the abilities or the temperamental personality dimensions. Part of our exploratory aim here is actually to map the sheer degree of change which is characteristic of these three different modalities and to give some initial norms regarding the amount of change to be expected in twelve-year olds over a one-year period.

It has been timely for our study and for all research in this area, that a collection of original papers seriously tackling for the first time the problems of change has recently been published (1962) under the editorship of C. Harris. As one of the writers, Bereiter properly points out, one of the main problems is to separate fluctuations due to unreliability and differences in validity of instruments from the true function fluctuation in the trait itself. The second problem is the intrinsic low reliability of any difference score, for, as Bereiter and others have pointed out, the reliability can only be as great as the product of the reliabilities of the two measures concerned, and is often less. These problems have also been systematically discussed by the senior author here in a chapter on Change Measurement in the HANDBOOK OF MULTIVARIATE EXPERIMENTAL PSYCHOLOGY, 1965.

Research is at an exploratory, pioneer level also in regard to the methodology of family attitude measurements. For although family attitudes have been measured by verbal test devices with results of varying consistency, it remains true, as mentioned above, that nothing has been previously constructed with objective motivation measurement devices, and nothing has been done in terms of attempting to represent attitudes within the family as vectors in an ergic coordinate space, i.e., to define the strength of an attitude in terms of the drives which are obtaining satisfaction through it.

2. The Main Design

Whereas in the main previous "static" study cited above (1961) groups of school children at one age level were tested simultaneously for school achievement and for factors in the three domains--ability, personality and motivation--now the main design called for repeating this testing by measuring a large sample of children at junior high school age (13-14 years), namely seventh and eighth graders on two occasions a year apart. As before, this testing consisted of a battery of ability, personality and motivation interest tests, together with scholastic achievement data. A second part of the design consisted in taking as many children as we could obtain with parents cooperative enough to enter the family attitude experiment, and, on this sub-set, to obtain attitude measurements on the parents and children, as well as social work home background information on environmental conditions which might be considered additional predictors of school achievement. In pursuit of fuller determination of typical degrees of stability, as desired information in itself, we also gathered data over a two and one-half year period for three distinct occasions of measurement. This became available mainly for the achievement scores, not to the personality, ability and interest scores, and the data has to be analyzed in the above respect only.

A conspectus of the subjects used, for whom complete tests for the first and second measurement sessions are available is given in Table 1, together with characteristics (age and sex) of the sub-group which was used for the family attitude studies.

Table 1

Subjects, Occasions of Testing, and Types of Measurement Obtained

Occasion	Group	No. of Boys	No. of Girls	Total	Grade Level	Tests Given
1. March 1961	A	33	38	71	7th	Metropolitan Achmt. Test
2. March 1962	A	38	43	81	8th	Metropolitan Achmt. Test
	B	40	41	81	8th	California Achmt. Test
3. May 1962	B	72	79	151	8th	School Motivation Analysis Test
	B	72	79	151	8th	HSPQ Forms A and B
4. January 1963	B	72	76	148	9th	Calif. Achmt. Test
5. March 1963	A	36	42	78	9th	Metropolitan Achmt. Test
6. May 1963	B	73	80	153	9th	Family Attitude Measmt.
	B	65	65	130	9th	School Motiva. Analy. Test (Unintegrated)
	A	41	44	85	9th	School Motiva. Analy. Test (Integrated)
	A	33	43	76	9th	HSPQ Form A
	B	72	77	149	9th	HSPQ Form B

3. Comments on Nature of the Tests

A relatively detailed description of the tests employed is given in Table 2. It should be noted that in regard to achievement tests we had no choice but to use what the schools had already settled upon, and these turned out to be different in the two systems. The rest were according to plan, and even in achievement we could add a measure--mean classroom grades--scored as seemed best for this design.

Table 2

Complete List of Achievement, Ability, Personality and Dynamic Measures and Observations Used in the Testing and Re-Testing

Measurement Aim	Test	Details	Source
School Achievement	1. Metropolitan Achiev. Test	10 subtests + overall score	school records
	2. Calif. Achiev. Test	6 subtests + overall score	--
	3. Grade Averages	5 subjects over 2½ semesters	--
Ability	Calif. Test of Mental Maturity (CTMM)	verbal, performance + total score	school records
Personality	High School Personality Questionnaire (HSPQ)	Forms A + B each measuring 14 factors by 142 items	Administered by research team
Motivation	Proto School Motivation Analysis Test (PSMAT)	Measures 15 factors by 4 different methods and over 300 items	Administered by research team
Family Attitudes Children	Proto Family Attitude Measure for Children (PFAM)	18 factors derived from 38 attitudes each measured by 4 different methods, with a total of over 600 items	Admin. by Research team
Family Attitudes Parents	Proto Family Attitude Measurement (adults)	12 factors each measured by 4 devices with a total of over 400 items	Administered by Research team
Family Information	Pre Coded Interview Schedule	1 hour interview	Research worker

As Cattell's findings on the theory of fluid and crystallized ability (1963) bring out, the traditional intelligence test is already appreciably contaminated with achievement. If one wishes to analyze out the true role of intelligence per se it is necessary to use a Culture Fair (fluid ability) intelligence test, but time demands forced us to reducing the sample on the Culture Fair Scale 2 and we had instead to depend on the schools achievement contaminated instrument (the California Mental Maturity scale). In accordance with the evidence cited in Chapter 1 we used for personality the High School Personality Questionnaire which measures fourteen factors. This was used in both its A and its B form for increased reliability.

In the motivation area, we used the as yet unpublished instrument resulting from the work of Sweney, Radcliffe, Baggaley, Horn, Cattell and others (1963) and tentatively called the PMT (Proto Motivation Test). These researchers have shown that certain objective test devices, notably autism, projection, information, and word association have concept validity against motivation component factors in measuring the strength of attitudes. They have also shown that the structure of interests falls into some six to ten distinct ergs and certain sentiments, such as sentiment to home, to school, to country, to sports, to other hobbies, etc. Our instrument, the PMT, had the following 15 categories in it.

Table 3

Structure of the Dynamic Factors in the Motivation Test (PMT)

A. Ergic Factors

1. Assertiveness
2. Sensuality
3. Sex
4. Gregariousness
5. Narcissism
6. Constructiveness
7. Protectiveness
8. Curiosity
9. Aggressiveness
10. Play Phantasy
11. Acquisitiveness

B. Sentiment Structures

12. Self Sentiment
13. Super Ego
14. Religion
15. Patriotism

4. Intended Analysis of Results

It will be helpful for the reader in perceiving the design if we outline before the actual analysis of results the analyses intended.

Had time and resources permitted we would have liked to examine the foundations in our tests themselves by re-factoring the personality and motivation areas--though only the latter may be said to be still open to possible alternative resolutions. However, circumstances (computer breakdowns at the University) compelled us to accept the previous analysis and to treat the scores as essentially factor scores by previous factor patterns.

The main analyses contemplated were therefore:

(1) Correlations of the personality, ability and motivation scores separately with the achievement score, both on occasion one and occasion two. A multiple correlation was then calculated showing the total prediction. Additionally, the multiple correlation for the ability

measures alone, the personality measures alone, and the interest measures alone were compared with the amount of variance prediction from the total in the total multiple correlation.

(2) Analysis of the sheer magnitude of fluctuation over twelve months on the principle scores used. Such an evaluation of function fluctuation depends essentially on a comparison of an immediate test re-test reliability with the stability coefficient over the twelve-month period. By subtracting the error variance, obtained from the test re-test immediate correlation, from the magnitude of variance over the twelve months, as obtained from the stability coefficient, one is left with a variance due to the function fluctuation. This data is only available for certain measures.

(3) Examination of the relation of changes in personality and interest to changes in achievement, by correlating difference scores, in ways described below. This also permits proceeding to multiple correlations, though the low reliability yet obtainable for difference scores makes this at present largely a gesture in a direction of development which may later be expected.

(4) A preliminary examination of the evidence on the family attitude measures, using objective devices. Since a great number of relationships could be examined here, the present analysis cannot be said to be complete. However, it begins with a factor analysis of the attitudes of children to the parents measured by the different devices, and is concerned with checking the hypothesis that dynamic structure factors will appear here which are on the one hand drives, or ergs, and on the other the father or mother as a single sentiment object.

The analysis also moves to the relation of these measures to ratings made by the visitor on the attitudes of child to parent and of parent to child.

5. Some Technical Issues in Preparing The Measurements for Analysis

The general measurements of intelligence on the traditional intelligence tests, of personality factors and scores in stens on the High School Personality Questionnaire, etc., are well known and need no description or explanation. However, the dynamic measures are a special "technology" needing some explanation, and the change measures in all realms need involved assumptions which must be made explicit. Incidentally, although such tests as the HSPQ, the intelligence tests, etc., are capable of being translated to standard scores, e.g., stens, we made no such changes from the raw scores since, in the realm of research, correlations and differences can be obtained with less loss of information by using the raw scores, and it was only in special cases and where comparisons were needed with other groups that the sten scores were used. The following scoring points need special consideration:

1. Change Scores

(a) As is now well realized, good scale qualities are particularly important in difference score measurement. In general it is desirable to have both the before and the after measures made into a single normalized distribution and to take the difference scores in standard scores on this distribution. However, in the first investigation, and since exactly the same tests are being used on the first and the second occasion with similar distributions, we have in the greater part taken simple difference scores which will be called "raw score differences".

(b) The second type of measurement which we have used is one in which the regression of the second on the first occasion of testing was calculated and the difference between the observed and the predicted second occasion score was computed. This method, originally proposed by Lord (1952), makes the change score independent of the initial score, which gets rid of some error in the initial score from the change score, but is not defensible for all types of measurement. Similarly, difference scores were computed between second and third and first and third occasions of testing where a third occasion existed. These scores will be called "regressed or level-free difference scores", and they have the form $S = B - rA$, where A and B are the two standard scores and r is the correlation between them.

2. Correction of Skewed Data

Our preliminary examination showed that the distribution of scores on the Metropolitan Achievement Test was negatively skewed, and the range of raw scores was consequently not well fitted for a difference score. Therefore, individual scores were changed to simple rank ordering and a difference taken between first and second and second and third occasions of testing. This score, only used in this connection will be called a "rank order difference".

3. Grade Change Scores

(a) Method one: The students' grades over two and one-half years were available and change in grade was computed therefrom as follows.

With each school subject in turn a student was given a +1 if his grade in the next semester was one higher (+2 if it were two grades higher) and -1 if it were one step lower, etc. These scores were summed across English, spelling, arithmetic, social studies, and science, to provide a total which reflected how the student changed in the sum total of his grades. Thus a high positive score indicated a decided upward trend (over all subjects) and a high negative score indicating a downward trend. This score was called a "trend in grades" score.

(b) Method two: Grade change was also computed for all subjects but by calculating a total grade for each year and taking the difference between the two years. This was called "the year grade change".

It will be noticed that we have to keep in mind two arithmetic meanings in regard to the achievement test scores. The grade scores should typically average the same from year to year, whereas the achievement test scores are not rescaled for each year but are on an absolute basis so that for example the seventh grader should score more highly in the seventh than he did in the sixth grade if he made normal progress.

6. Inter-Relations of Change Scores on the Criterion

While discussing the change score problem it is relevant to make a preliminary analysis of how changes behave on the criterion itself, so that we may proceed with more understanding to the relating of the criterion to the predictors. It will be remembered that the Metropolitan Achievement Test was administered in the springs of 1961, 1962 and 1963. Change scores have been calculated over this period with the results set out above and intercorrelated in Table 4.

Table 4

Correlations Among Modes of Scoring Change and Over Periods of Change

(a) Correlations of Measures of Change for California Achievement Test. (Occasion 2 to 3)

	1	2	3
1. Raw Differences (1 to 2)	----		
2. Regressed Differences (1 to 2)	.789	----	
3. Rank Order Differences (1 to 2)	.730	.942	----

(b) Correlation of Measures of Change for Metropolitan Achievement Test (Occasion 1 to 2)

	1	2	3
1. Raw Differences	----		
2. Regressed Differences	.140	----	
3. Rank Order Differences	.759	-.095	----

(c) Correlation of Measures of Change for Metropolitan Achievement Test (Occasions 2 to 3)

	1	2	3
1. Raw Differences	----		
2. Regressed Differences	-.001	----	
3. Rank Order Differences	.671	.072	----

As far as the California Achievement Test is concerned, the method of regressed differences (due to Lord (1952)), the direct raw score differences, and the rank order differences all intercorrelate substantially. As far as regressed differences and rank order differences are concerned the agreement is excellent and it seems we need not bother much about the form.

On the other hand, the results from the Metropolitan show new features, the raw and rank order alone having acceptable agreement.

We can only suggest that the difference resides in the relation of the within year to absolute variance being different in the two tests.

Some further points of interest are the relation between (1 to 2) change and (2 to 3) change, in Table 5.

Table 5

Relation of Change in Successive Periods

	Raw	Regressed	Rank
$r_{(1 \text{ to } 2)(2 \text{ to } 3)}$	-.17	.71	-.31

Again the raw and rank differences make better sense. Since one is using practically the same absolute level for each individual as subtrahend in the regressed score calculation on the two occasions a spurious correlation is produced between them by this common figure. The slight negative relations of (1 to 2) with (2 to 3) on the other scores make sense in terms of (a) error of measurement on occasion (2) would add to one and subtract from the other, (b) so would "function fluctuation", and (c) a homeostatic principle might possibly suggest that larger effort in one period would truly lead to some relapse in the succeeding period.

These concrete instances--and others we could give of large correlations from including one change period within another--may suffice to support our point that change scores need to be very critically examined, and our argument that unchanged "raw scores" from well scaled (normalized at least) scores are in general better than partialling out initial and final scores, etc., which introduces risks of spurious and highly unpredictable correlations. For example (see

Chapter 7), many things which correlate with the initial level will, as a result of method 2, correlate negatively with gain.

In the total (5 subject) grades as distinct from the achievement tests, it will be recalled that we tried two computations, called the grade trend and the year grade change. These correlated with each other +0.58. They did not, however, correlate more than trivially (0.10) with the California and Metropolitan increments (Table 4 data), due either to the different emphases on school subject areas or to some intrinsic differences in the values used in the classroom, "creative" performance contrasted with those in the multiple choice factual achievement measures. Obviously we must report results separately for grade change and for standard achievement test change.

It should be noted that we are not asserting such a radical difference in the absolute measurements, which, as Table 6 shows, with the exception of Metropolitan on occasion 1, correlate at about the usually obtained level. We must therefore conclude that the sources of variance in change in grade and in change in achievement test are substantially independent year by year.

Table 6

Correlations Between "Static" Grade and Achievement Test Scores

	Year Given	Grade
Met. 1	1961	.277[1]
Met. 2	1962	.575
Met. 3	1963	.574
Cal. 1	1962	.691
Cal. 2	1963	.625

[1] This correlation is a measure of the relationship between a test taken in 7th grade and total grade average over the whole 7th, 8th, and 9th grade period. Possibly the correlations between these variables increase over time.

Chapter 3

The Static Prediction from Personality to Achievement and the Magnitude of Personality and Interest Change

1. The Static Prediction of Achievement at a Given Occasion

As pointed out in the introduction, at least five or six studies are now published or in course of publication giving consistent directions of influence of personality factors upon school achievement. The analysis of our results for Occasion 1, using the standardized achievement tests, are shown in Table 7.

Table 7

Correlations of Personality and Dynamic (Interest) Factors with Achievement (One Occasion Only)

Personality Factors (HSPQ) A and B Forms	
Factor:	
A	.13
B	.50
C	-.08
D	.03
E	.01
F	.13
G	.21
H	.03
I	.10
J	.01
O	.01
Q_2	-.19
Q_3	.24
Q_4	.02

	Dynamic Factors Unintegrated	Integrated
Ergs:		
Assertiveness	-15*	09
Sensuality	08	-46**
Sex	-06	26*
Gregariousness	18*	-27*
Narcissism	-06	-06
Constructiveness	-18*	-21*
Protectiveness	-34**	02
Curiosity	06	16
Pugnacity	-16*	-04
Play Phantasy	07	-01
Acquisitiveness	11	09
Sentiments:		
Self Sentiment	03	06
Super Ego	-02	04
Religion	04	03
Patriotism	13	11

N = 130 8th and 9th grade boys and girls.
* differs from zero in $P < .05$.
** differs from zero in $P < .01$.

The correlations are smaller than in previous researches for personality factors, only 5 of 16 being significant, and one--that for surgency, F--is different in direction from previous research. Confirmation is given, however, for the usual r of 0.5 with intelligence, and for super ego strength (G) and self sentiment development (Q_3) being positively related to school achievement (see page 26). Ego strength here does not play its usual role.

The dynamic structure factors are scored separately for their Unintegrated and Integrated components, unlike the one previous research, because evidence in the interim has suggested they may behave very differently. The present results definitely support the desirability of taking U and I components separately. As a comparison with results in Chapter 1 show, there is confirmation in a negative relation to assertiveness, pugnacity and constructiveness. Additionally, we find strong negative relations to sensuality (integrated), and protectiveness (unintegrated)--at $P < .01$ in both cases. A curious result is seen in the positive relation to integrated sex interest, and in gregariousness being oppositely related in its integrated and unintegrated forms. No theorizing about these curiosities will be attempted until they are confirmed.

As a matter of practical interest the multiple correlation with achievement when various batteries are used is presented in Table 8.

Of these values it may be said that except for the smaller contribution from the dynamic structure factors (PMT) they line up well with those from the previous main "static" study (Cattell, Butcher, Connor, Sweney and Tsujioka, 1961). They indicate, as regards grades, that personality factors yield approximately the same (actually slightly more) prediction than intelligence and that intelligence and personality (separately) yield more than can our present measurement of dynamic factors. The three modalities are largely non-overlapping as predictors and their joint contribution approaches 2/3 rds of the variance of the criterion, as in the previous research.

Table 8

Multiple Prediction of Achievement From Certain Combinations of Intelligence, Personality and Motivation

Instruments	Number of Independent Variables	Prediction of (1) Standard Achievement		(2) Grades	
			*		*
Dynamic Structures (Both U and I)	30	.52	.28	.48	.16
HSPQ (A and B), Without Intelligence	26	.52	.33	.60	.46
HSPQ (A and B), With Intelligence	28	.79	.73	.75	.68
HSPQ (A and B), plus Dynamic Structures	59	.85	.73	.81	.65

N = 130
* Corrected for shrinkage.

2. The Magnitude of Fluctuations in Personality Over A One-Year Period

The magnitude of changes on the High School Personality Questionnaire over a one-year period have never been systematically investigated, though certain stability coefficients over shorter periods exist as by-products from various researches on small samples. The comparison of these trait stability coefficients with test dependability (immediate re-test) coefficients has at least indicated that real trait changes can arise even over a few months.

Changes may be thought of as (a) trends and (b) fluctuations. To evaluate the former, difference scores were first obtained for second minus first occasions of testing. Owing to exigencies of testing time, not all subjects did both forms of the test on both occasions; however each subject did at least one form on each occasion. The mean changes are set out in Table 9.

Table 9

Mean Trend Changes (One Year) in HSPQ Factors

	Group 1					Group 2	
Form A	Boys (33)	Girls (43)	Form B	Boys (72)	Girls (77)	Boys	Girls
A	-.121	+1.535**	A	+.736	+.636*	+.228*	+.423*
B	+.364	-.116	B	+.542	-.195	+.440*	+.616*
C	-.939	+1.116	C	+.056	+1.208*	+.163	+.088
D	-1.333	+.512	D	-.875	-.299	-.445*	-.392*
E	-1.879	-.442	E	-.569	-.156	+.280	+.315
F	-.212	+.047	F	-.236	+.221	+.072	+.364
G	+1.636*	+.930	G	+1.694*	+.857	-.054	+.279
H	+.576	+2.093**	H	+1.264*	+.909	+.094	+.307
I	-.697	+1.279*	I	-.389	-.364	-.437*	+.035
J	-1.212	-1.102*	J	+.069	+.208	-.110	-.323*
O	-.061	-.163	O	+.403	+.143	-.342*	-.209
Q_2	+.121	-.209	Q_2	+.375	+.104	-.037	-.256*
Q_3	+1.333	+1.791*	Q_3	+.132	+1.104*	-.096*	+.044
Q_4	-.394	-.140	Q_4	-.486	-.935	+.104	+.130

* The difference is statistically different from zero with a probability of $P < .05$.

** The difference is statistically different from zero with a probability of $P < .01$.

In the last two columns are quoted the best fit regression coefficient of personality on age over this period as measured by HSPQ. These figures, taken from Cattell and Sealy (1965) are based on a sample of over 4,000 and can thus be regarded as the best estimate of personality change over this period on the HSPQ. It will be seen from inspection that the changes found here over a one-year period are fairly similar to the regression lines found in the previous study (the rank order correlations being about $r = +.20$ for boys and +.21 for girls were not, however, significant). The import of these results is that in this sample boys increased significantly in scores on factors G (Super ego strength) and H (Adventurousness) while girls' scores increased over the year on factors A (Sociability), C (Ego Strength) and H (Adventurousness), I (Sensitivity), Q_3 (Self Sufficiency) and declined significantly on J (i.e., became more gregarious).

The main differences between the results here and the general population results are that here the boys become more submissive (E), depressed (F), and conscientious (G), less self sufficient (Q_3) and less frustrated and tense (Q_4); none of these trends were significant for the general population, so the differences are not important. All the trends that were significant for the general population (A, B, D, I, and O) are repeated here for direction if not for magnitude, except for O (Guilt-proneness) which decreases significantly over this period of adolescence for the general population, but here tends to increase slightly.

For girls in the general population trends on factors A, B, D, E, J, and Q_2 were all significant and were replicated in this study for direction, if not magnitude, apart from factor B, where the girls in this sample declined slightly, and non-significantly in scores, and factor E (dominance); in this sample the girls tend to become more submissive instead of more dominant as general population girls tend to over this period.

An important difference should be recognized, however, between the two sources of evidence we are comparing: here the samples were tested twice, one year apart, whereas the general population trends were computed from separate samples of students for each age. The former, as pointed out by Cattell and by Schaie, gives normal biological and culture-induced changes in personality during these adolescent years, whereas the latter confounds historical cultural change with personal change. Thus, except when we can control these variables, we need not expect trends found from sampling of the various ages, necessarily to be repeated perfectly when we do the present test—re-test type of study. However, despite all these qualifications, the convergence of the results described here is very satisfactory.

Let us conclude this section by briefly summarizing the changes:

(a) Over this period boys get significantly higher scores on Super Ego Strength (G) and Adventurousness (H), and tend to score higher on Intelligence (B), Sociability (A) and O (Guilt Proneness).

(b) Boys tend to score lower on D (i.e., become less excitable), E (becomemore submissive), and I (become more tough minded).

(c) Girls score significantly higher over the year on factors A (Sociability), H (Adventurousness), I (Sensitivity), Q_3 (Self Sufficiency), C (Maturity and Ego Strength) and they tend also to score more highly on Super Ego Strength (G).

(d) Girls score significantly lower over this period on factor I (more Gregarious) and tend towards lower scores on E (i.e., more Submissive) and Q_4 (less tense and frustrated).

The extent of sheer fluctuation of trait per individual can best be evaluated by comparing the straight re-test (dependability coefficient) values from the HSPQ Handbook with those obtained here for re-test over a year, in Table 10.

Table 10

Dependability and Stability Coefficients on HSPQ

Factor	Dependability* (Two Forms)	Dependability (One Form in Present Group)	Stability (Form A and B Mean)
A	.74	.51	.40
B	.75	.50	.36
C	.77	.45	.37
D	.78	.52	.38
E	.72	.48	.32
F	.68	.46	.29
G	.71	.43	.32
H	.80	.60	.42
I	.79	.61	.58
J	.69	.50	.33
O	.72	.47	.37
Q2	.70	.45	.31
Q_3	.73	.50	.34
Q_4	.78	.60	.40

*Note, in the Handbook these are labelled "stability" since two weeks elapsed between testings. But in the context of our period of one year, these are close to test dependability, and the one year stability of trait is compared therewith.

The values in the last column are the means of those found for the two forms, in Table 17, to be comparable with the adjacent column.

3. Changes in Dynamic Structure Factor

Motivation Levels Over A Year

A similar examination was next made of the constancy of the dynamic structure factor levels on the PMT, beginning with an examination of trend. Table 11 sets out the differences in raw score and shows which are significant (by a two tailed test) at $P <.05$, $<.01$ (and also $<.015$).

Table 11

Mean Changes (and Sigmas) on Dynamic Structures (Ergic Tensions and Sentiments) Over One Year

Unintegrated Component Scores

	Boys (65)		Girls (65)	
	Mean	Sigma	Mean	Sigma
Assertiveness	+.062	2.487	-.231	1.703
Sensuality	-.446*	1.521	-.523*	1.532
Sex	+.600**	1.748	+.308	1.478
Gregariousness	+.031	1.837	+.108	1.501
Narcissism	+.215	1.615	+.385*	1.399
Constructiveness	+.154	1.797	-.200	1.669
Protectiveness	-.477*	1.562	-.985**	1.515
Curiosity	-.369	1.892	+.092	1.508
Pugnacity	+.015	1.527	-.062	1.236
Play Phantasy	+.246	1.829	-.477*	1.778
Acquisitiveness	+.354	1.916	-.108	1.592
Self Sentiment	+.646**	1.891	+.492*	1.678
Super Ego	-.538*	1.921	-.415	1.862
Religion	-.323	1.863	-.215	1.420
Patriotism	-.231	1.647	-.062	1.530

Integrated Component Scores

	Boys (65)		Girls (65)	
	Mean	Sigma	Mean	Sigma
Assertiveness	+.072	2.630	+.176	2.657
Sensuality	+.073	2.381	-.118	2.772
Sex	+.537	3.450	-.324	2.749
Gregariousness	+.390	3.247	-.353	2.281
Narcissism	.000	2.784	-.441	2.631
Constructiveness	-.122	2.865	-.088	2.429
Protectiveness	+.390	2.948	+.324	2.184
Curiosity	-.927	3.093	1.294*	2.780
Pugnacity	-.122	2.731	+.441	2.427
Play Phantasy	+.439	2.440	+.176	2.576
Acquisitiveness	+.098	3.345	+.206	2.422
Self Sentiment	+.171	2.756	+.382	2.462
Super Ego	-.756	2.905	+.135	2.562
Religion	+.341	2.988	-.206	2.750
Patriotism	-.268	2.829	-.706	2.406

Differences equal second occasion minus first occasion.

* P < .05
** P < .01

From these tables it would appear that there are decidedly more significant changes on unintegrated than on integrated measures of motivation. It is impossible to be sure whether this represents some real difference in the stability of motivational components or whether it is some kind of artefact resulting from either the type of measure or type of scoring procedures used. For unintegrated measures boys get significantly higher scores on the second occasion for the sex erg and self sentiment and significantly lower scores on sensuality, protectiveness and super ego sentiment. Girls get significantly higher scores on self sentiment and narcissism and lower scores on sensuality, protectiveness, play phantasy. On all of the factors mentioned, changes for boys and girls are in the same direction--and this holds for significant changes also in the integrated components.

The heightening of the sex drive and the increase in narcissism for girls represent changes that might well have been anticipated, and consonant with clinically observed changes in personality. The increase, for both boys and girls in self sentiment development is also consistent with general psychological theory and with the Q-data measure of what we know to be the same factor. On the other hand we have an apparent contradiction in that the dynamically measured super ego sentiment--unlike factor G in questionnaire measurements--tends to fall over this period both for boys and girls. From the work of Gorsuch we know now that although these factors had had similar titles they are in fact distinct. Factor G from the questionnaire domain puts much emphasis on conscientiousness, perseverance, responsibility and attentiveness to rules and people; whereas in the super ego sentiment, dynamic attitudes are being measured, namely, desire for greater self-control and admiration of father.

As far as changes in the form of trends are concerned, therefore, we can at least conclude that over this 14th year both boys and girls show significant increases in the strength of the sex erg, the narcistic erg and the self-sentiment, with decreases in simple sensuality, in protective need, in the super ego as measured dynamically and (for girls only) in the play phantasy need.

In regard to irregular, individual fluctuations or "instability" however, we have still to compare reliability and stability coefficients. As can be seen from Table 12 the magnitudes of the correlations between occasions for the motivation-interest variables are decidedly lower than for the corresponding figures of the HSPQ. This is to be anticipated since personality is considered to represent more stable individual characteristics, while motivation, though measuring factors thought to represent biological drives and enduring socio-cultural complexes of motivation, is hypothesized as being more responsive to stimulus situation and gratification level (see formula in Cattell, 1959). Thus one can anticipate relatively larger shifts in the motivation area (though the absolute numerical values may appear less than these for HSPQ through differences in raw score scales).

That reliabilities should be so low is perhaps unavoidable in developing such a novel form of measurement technique. Steps are in progress to discover what changes in design may hope to increase the test dependability. However, we may note that the integrated measures throughout have higher dependabilities and stabilities than the unintegrated components. Whether the differences in stability are largely due to differences in dependability of test is something which only further analysis can show. From inspection one gets the impression that assertiveness and protectiveness, especially, have greater test dependability than trait stability, and all along the line the lower stability suggests that the traits themselves are less stable in level than ability and possibly than personality traits. Some light can be thrown on the meaning of Table 12 by the degree of significance of relations found below with dynamic trait charge scores.

Table 12

Dependability and Stability Coefficients

(Over One Year) of the Dynamic Structure Factors

	Trait Stability (N = 128)		Test Dependability (N= 190)	
	Unintegrated	Integrated	Unintegrated	Integrated
Ergs				
Assertiveness	-04	22	13	52
Sensuality	24	20	20	45
Sex	04	34	11	50
Gregariousness	26	30	22	30
Narcism	21	43	21	50
Constructiveness	13	25	15	33
Protectiveness	-01	11	22	50
Curiosity	18	22	25	45
Pugnacity	36	10	19	38
Play Phantasy	32	40	15	39
Acquisition	06	28	19	42
Sentiments				
Self Sentiment	05	28	14	40
Super Ego	11	35	17	36
Religion	11	26	17	41
Patriotism	26	30	15	41

Chapter 4

The Relation of Absolute Level of Ability, Personality and Interest to Changes in School Performance

1. Change of Achievement in Relation to Intelligence, and Sex of Child

Let us at this point remind the reader that in principle we have four kinds of data to inter-relate: (1) Achievement level fixed at some point in time, (2) Personality and motivation characters at a fixed point, (3) Achievement change, and (4) Personality and motivation change. These yield, mathematically, six possible relationships, of which three are central to our present research: (a) Relation of absolute achievement to absolute personality and ability characteristics--the familiar area of psychometrics, (b) Relation of absolute personality level to achievement change, and (c) Relation of personality change to achievement change. The present chapter is concerned with (b), while the ensuing chapter will approach the (c) topic.

It would seem best to begin by examining the relation of achievement change to intelligence and to the sex of the child, since these are landmarks in any discussion of the issues here and voluminous research has centered for decades on intelligence and achievement. Almost all of this intelligence research, however, has related intelligence fixed at a point to achievement fixed at a point. While studies of the relation of intelligence to achievement change are not altogether new, they are altogether more rare than studies of relation of school performance to intelligence statically. A major contribution was made in the pioneer studies of Woodrow (1945) which showed that the general factor in scholastic change which one might have expected did not actually exist--at least with ordinary scoring methods.

Table 13

Correlations of Intelligence with Achievement Level and Gain*

Achievement Level	
Occasion 1. Mean of Metropolitan and California	.52
Occasion 2. Mean of Metropolitan and California	.57
Occasion 3. Metropolitan only	.67
Achievement Change	
Regressed Measure (Mean of 4, Met. & Cal.)	-.03
Rank Change (Mean of 3, Met. & Cal.)	.13
Raw Score Change (Mean of 3, Met. & Cal.)	.05
Grade trend	-.12
One Year Grade Difference	-.25

*The word Gain rather than Change is used here because change is now scored in the positive direction.

Although the "static" correlations with absolute level are those typically found the correlations with change are essentially zero. (Possibly rank change, on standardized tests, is slightly positive and on grades slightly negative.) The most likely hypotheses is surely that with intelligence tests (the California and the Verbal, B factor in the questionnaire) which are essentially crystallized general ability, this represents the mean of two tendencies: (1) A slight positive correlation between fluid intelligence and gain in achievement, and (2) A slight negative correlation between the last achievement measure and the next gain in intelligence. The source of the latter we have ascribed above to both error and homeostasis.

The relation of achievement gains to the sex of the child is shown in Table 14.

Table 14

Sex in Relation to Achievement and Achievement Gain

Achievement Change	
Raw Met. Occasions 1-2	-.254
Raw Met. Occasions 2-3	.141
Regm. Met. Occasions 1-2	.071
Regm. Met. Occasions 2-3	-.226
Regm. Met. Occasions 1-3	-.334
Rank Met. Occasions 1-2	-.097
Rank Met. Occasions 2-3	.156
Raw Cal. Occasions 2-3	.007
Regm. Cal. Occasions 2-3	.096
Rank Cal. Occasions 2-3	.020
Grade Change Occasions 2-3	.050
Semester Grade Change Occasions 2-3	.020

Absolute Achievement		
Actual Achievement	Met. 1	-.061
Actual Achievement	Met. 2	-.146
Actual Achievement	Met. 3	-.112
Actual Achievement	Cal. 1	-.075
Actual Achievement	Cal. 2	-.009
Total Grade		-.137

Since sex is scored positive for boys in the above point biserials we may conclude that as usual girls are doing slightly better than boys. However, the greater and significant size of the gain (change) score correlations suggests that at this age (12-15 yrs.), in which girls are considered to mature more rapidly, they also accelerate in school achievement more than the boys.

2. Achievement Gains and Absolute Level of Personality Factors

Before these results can be fully appreciated the time sequences of our observations require some recapituation. The first Metropolitan Test was administered in spring, 1961; the first California and second Metropolitan Achievement Test and HSPQ, IPAT personality test were administered in spring of 1962; the second California, third Metropolitan and second IPAT personality test were given in spring, 1963. Thus the main interests center on the correlation between the personality factors and the changes on the California and Metropolitan tests (and the grade changes) between the second and third occasions. However, all the correlations will be quoted for completeness' sake in Table 15.

It has been shown above (Table 4) that agreements between various methods of computing change score are generally only tolerable and sometimes poor. The raw and rank order methods are in best agreement. It is perhaps unfortunate that for the longest period of change--occasion 1 to occasion 3--we have only one achievement test* and one mode of computing change. However, the agreement across periods and across methods can be seen to be tolerable. For example, Q_2 has five out of seven coefficients significant in the same (negative) direction and H has all positive and two of them significant.

Among the most consistent and significant results are the positive relation of gain to super ego strength, G, and to parmia, H, and the negative relation to self sufficiency, Q_2. Beyond this there are indications of positive relations to surgency, F, and to strength of

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*It is impossible to gauge the correlation between change on the Metropolitan and change on the California achievement test, since no one took each test twice. However, it is known that the second testing on the California correlated with the various Metropolitan tests the subject took from .68 to .72; it is also known that the Metropolitan Test had a very negatively skewed distribution (i.e., many subjects actually getting maximum scores.) Thus the relationship between measures of change based on these tests can be thought of as follows: They share some common variance, but the scores based on the Metropolitan contain more error, through their skewed distribution, than those based on the California test. In any event both are measuring something different from the sort of improvement scores based on grades.

Table 15a

Correlations Between Personality and Change in Achievement on Metropolitan Test

HSPQ, Form A

Factor	Raw Differences		Regressed Differences			Rank Order Differences	
	Met 1-2 N=69*	Met 2-3 N=72	Met 1-2 N=56	Met 2-3 N=52	Met 1-3 N=52	Met 1-2 N=71	Met 2-3 N=73
A	.081	-.144	.015	.129	.150	.092	-.002
B	.021	-.427**	-.091	-.014	.045	.155	-.153
C	.113	.007	-.016	-.045	-.055	-.010	.009
D	-.058	-.052	-.085	-.046	.002	.058	-.157
E	.049	.076	.150	.079	-.042	.065	-.017
F	.118	-.049	.064	.185	.182	.226*	-.115
G	.247*	-.062	.040	.178	.226*	.048	.104
H	.147	.098	.078	.202	.212	.003	.284*
I	-.003	-.243*	.038	.098	.087	.025	-.049
J	-.179	-.037	.131	.015	-.136	-.168	.068
O	-.074	-.098	.140	.141	-.013	.121	-.201
Q_2	-.271*	-.067	-.137	-.333**	-.294*	-.242*	-.214
Q_3	-.104	.126	.212	.024	-.130	-.109	.297*
Q_4	-.077	.007	-.123	-.060	.017	.116	-.177

*For various reasons of incompleted tests, etc., the N's are not identical for the same interval.

HSPQ, Form B

A	.200	-.093	.111	.263*	.285*	.223*	.015
B	.151	-.314**	-.249*	-.045	.204	.185	-.103
C	.196	.149	.069	.083	.053	.100	.153
D	-.187	.036	-.036	-.116	-.203	-.117	-.168
E	.059	.191	-.012	-.123	-.207	-.001	.102
F	.052	-.042	-.041	.111	.135	.074	-.047
G	-.152	-.041	.050	-.023	-.062	-.121	.168
H	.241*	.018	.097	.222	.231*	.203	.037
I	-.036	-.058	-.099	-.005	.029	.030	-.024
J	-.214*	.024	-.083	-.210	-.224	-.150	-.094
O	-.141	-.101	.080	-.026	-.157	-.052	-.181
Q_2	-.244*	.150	-.029	-.168	-.178	-.229*	.104
Q_3	-.086	-.012	.002	-.061	-.046	-.048	.027
Q_4	.159	-.188	.111	.286*	.224	.099	-.146

self sentiment, Q_3. Intelligence and factor J are suggestive of negative relations, the former result agreeing with results from other methods of measuring intelligence, mentioned in the last section.

Incidentally, the main contrast presented by the correlations with the grade-change scores is that improvement in class grades is negatively related to Dominance (E), Adventurousness (H), and Intelligence and positively related to Q_4 (Ergic Tension) and O (Guilt Proneness). This may reflect some of the inescapable situational differences between the evaluation of grades by teachers and the impersonal scores on achievement tests. The group dynamics researches of Cattell and Stice (1960) showed that the thick-skinned (H) tend to be regarded as a nuisance by their peers (and surely no less by their teachers), while E factor, as we have seen, means a lack of docility in learning. In classroom performance we note also that guilt proneness and to some extent, sensitivity (I) are related to improvement.

This suggestion of systematic differences in the personality influences making on the one hand for good achievement performance gain in an impersonal examination on a fixed day, and on the other, for gain in performance watched over from day to day in the classroom, is deserving of more research. Evidently, as seen in the classroom, the dominant and adventurous individual is not seen as making at this period the progress expected of him. Is this a contrast effect in perception due to the discrepancy between the confidence shown in his personality and what he actually achieves, influencing the teacher's evaluation adversely? Or is it that at this juncture the incentives, in classroom work, for the "extravert" lose some of their appeal so

Table 15b

Correlations Between Personality and Change in Achievement On The California Achievement Test, and on Grades

HSPQ, Form A

Factor	Raw Diff.	Regressed Diff.	Rank Diff.	Trend in Grade	Grade Change Over Year
A	-.022	-.083	-.011	-.112	-.113
B	-.012	-.193	-.106	.024	-.164*
C	.141	-.046	.088	-.075	-.082
D	.002	.021	-.011	.031	.096
E	-.064	-.034	-.052	-.044	-.145
F	.109	.048	-.014	-.056	.033
G	.229*	.200	.216*	.011	-.080
H	.084	.056	.071	-.119	-.126
I	.040	.042	-.001	-.052	-.002
J	-.028	-.004	-.065	.087	-.032
O	.011	-.038	-.085	.070	.114
Q_2	-.061	.098	.088	.046	.016
Q_3	.212*	.128	.193	.041	-.115
Q_4	-.087	-.008	.003	.072	.144

HSPQ, Form B

Factor	Raw Diff.	Regressed Diff.	Rank Diff.	Trend in Grade	Grade Change Over Year
A	.140	.036	.002	-.177*	-.132
B	.429**	.140	.097	.015	-.076
C	.091	.089	.020	.072	.129
D	-.141	-.198	-.170	-.065	-.030
E	.042	-.059	-.058	-.058	-.055
F	.143	-.018	.021	-.150	.008
G	.081	-.014	-.003	.017	.038
H	-.044	-.060	-.151	-.026	-.074
I	-.051	-.051	-.016	-.009	.152
J	-.077	-.020	.063	.039	.057
O	-.011	-.031	-.005	.029	.142
Q_2	-.107	-.073	.017	.170*	.098
Q_3	.105	-.028	-.038	.008	-.139
Q_4	-.067	-.188	-.156	-.132	.017

that he neglects classroom work (though still actually doing as well in the important examinations)? Or is it that the guilt prone, sensitive child receives (like the less intelligent) more attention from the teacher and gets more sympathetically evaluated in those personal appeal valuations which enter into the grade but not into the standard test achievement measures?

Any drawing of inferences regarding this or other findings at the present juncture need more sophisticated discussion of change correlations than we have yet entered upon, and which are deferred to a later chapter. Meanwhile let us summarize the dynamic evidence.

3. Achievement Gains and Absolute Levels of Dynamic Motivation

It will be recalled from Chapter 1 that fairly substantial relations were found in the main pioneer study (Cattell, Connor, Sweney and Tsujioka, 1961) between absolute achievement and absolute motivation. The directions of these relations were confirmed in our own static, "absolute" analysis in Chapter 3, though for some reason the significances were lower. In the light of this background let us look at the evidence of correlation of achievement gains with absolute motivation as shown in Tables 16a and 16b.

As before, any fair overview of the evidence must consider different samples, different methods of calculating the gain, and different achievement measures (Metropolitan, California and Grades). This makes the tables cumbersome, but has the advantage of building in an evaluation of significance additional to that from the cut-and-dried statistical tests. For we can see the way in which quite modest correlations hold up--or do not hold up--across different samples and methods of measurement. Yet a further breakdown and possible comparison has been presented by breaking the motivation measures in the PMT into Unintegrated and Integrated, which reduces the reliabilities and correlations further, but makes a more global "off-table" judgment possible.

Table 16a

Correlations of Changes in School Performance With Dynamic Structure Level Scores (As Measured By Metropolitan Achievement Test)

Unintegrated

	Raw Differences		Regressed Differences			Rank Differences	
Factor	Met. 1-2	Met. 2-3	Met. 1-2	Met. 2-3	Met. 1-3	Met. 1-2	Met. 2-3
Assertiveness	-.057	.453**	-.014	-.081	-.101	-.047	.282**
Sensuality	.153	-.101	.110	.143	.048	.134	-.138
Sex	-.257*	.186	.140	-.039	-.279*	-.184	.034
Gregariousness	-.165	-.016	-.003	-.011	.004	-.199*	-.011
Narcism	.304**	-.159	-.249*	-.068	.204	.262*	-.116
Constructiveness	.035	-.343**	.133	.151	.120	-.048	-.270*
Protectiveness	.022	-.052	-.074	-.115	-.065	.011	.027
Curiosity	-.132	-.071	.063	-.038	-.112	-.040	-.042
Pugnacity	-.147	.283**	-.066	-.227*	-.258*	-.102	.173
Play Phantasy	.051	-.014	.127	.089	-.000	.210*	.053
Acquisition	.299**	-.161	.212	.442**	.348**	.141	-.045
Self Sentiment	-.017	-.064	-.055	-.026	.010	-.037	.008
Super Ego	.270*	-.117	-.082	.110	.286*	.267*	-.052
Religion	.017	.190	-.088	-.035	.013	.106	.159
Patriotism	.028	.100	-.187	-.256*	-.156	-.039	.161
Integrated							
Assertiveness	-.131	.005	-.104	-.195	-.074	.038	.049
Sensuality	.096	-.166	.243*	.257*	.125	-.056	-.187
Sex	.130	-.054	-.161	.125	.368**	.200*	-.253*
Gregariousness	-.068	.057	-.043	.016	.031	-.093	.196*
Narcism	-.021	-.081	-.166	.018	.123	.035	-.235*
Constructiveness	.111	-.047	.105	.060	-.005	.000	.010
Protectiveness	.129	-.052	-.026	.040	-.006	.069	-.044
Curiosity	-.113	.107	.107	-.009	-.115	-.237*	.228*
Pugnacity	-.084	.122	-.110	-.239*	-.176	-.124	.106
Play Phantasy	.067	-.014	.267*	.136	-.017	-.074	-.034
Acquisition	.287**	-.263*	.146	.428**	.430**	.175	-.096
Self Sentiment	-.080	-.192*	.100	.077	.034	-.055	-.015
Super Ego	.015	.139	.043	-.050	-.077	.028	.119
Religion	-.074	.073	.118	.046	-.105	-.104	-.008
Patriotism	-.107	.144	.030	-.143	-.203	-.167	.148

Any discrepancies between the 1-2 interval and the 2-3 interval must be considered in the light of the evidence already presented that there is a tendency for a slight but significant negative correlation in the gains over these two successive intervals, which we have sought to explain as due to (a) a systematic effect from measurement error on occasion 2 and (b) a homeostatic effect. However, in general greatest weight, here and elsewhere, should be given to evidence from the 2-3 interval, since it is here that the evidence is most complete, larger in sample, and gathered in circumstances more completely under our experimental control. Table 16b presents the results for the larger group studied with the California Achievement Test and for which Grade Change results are available.

Let us first consider the Unintegrated dynamic interest relationships, across Tables 16a and 16b separately. As before we shall discount the "regressed score" interpretations and heed the direct changes as shown by raw score and rank change, which agree better. The main noteworthy relations are with the ergs of Acquisitiveness, Sex, Narcism, Protectiveness and Pugnacity (Aggression) and with the sentiments of Super Ego and Religion.

Sex is negatively related to gain in the 1-2 interval and Protectiveness (altruism) to gain in the 2-3 age period. High Narcism, high Super Ego and low Pugnacity show a distinct and common pattern of being significantly positively correlated in the first age period and negatively in the second. For some reason a group difference exists in that those in the school system tested by the Metropolitan show a positive achievement gain (in the 2-3 period) with high Assertiveness and negative with high Constructiveness which is not present in the other group.

Table 16b

Correlations of Changes in School Performance With Dynamic Structure Level Scores (As Measured By California Achievement and School Grades)

Factor	Raw Diff. Cal 2-3 N=67	Regressed Diff. Cal 2-3 N=61	Rank Diff. Cal 2-3 N=61	Trend in Grades 2-3	One Year Grade Change 2-3
		Unintegrated			
Assertiveness	-.138	-.098	-.116	-.018	.043
Sensuality	-.029	-.087	-.171	-.018	-.129
Sex	-.088	-.178*	.057	-.053	-.016
Gregariousness	-.096	-.270 *	-.180	-.108	-.070
Narcism	-.284**	-.208*	-.215*	-.084	-.035
Constructiveness	-.014	-.028	-.087	.009	.086
Protectiveness	-.208*	-.115	-.229*	.121	.106
Curiosity	-.097	-.193	-.158	.064	-.141
Pugnacity	.126	.113	.126	-.039	.116
Play Phantasy	.039	.027	-.053	.110	-.033
Acquisition	.018	.116	.083	-.060	-.003
Self Sentiment	.115	-.071	.081	.072	.085
Super Ego	-.221*	-.182	-.095	.117	.055
Religion	.036	.098	.065	.168*	.128
Patriotism	-.020	.093	-.048	-.040	.068
		Integrated			
Assertiveness	.124	.158	.083	.026	-.142
Sensuality	-.166	-.027	-.166	-.079	-.002
Sex	-.096	-.137	-.058	-.073	-.005
Gregariousness	-.106	.044	-.040	-.051	.116
Narcism	-.015	.094	.074	-.049	-.023
Constructiveness	.099	.170	.214*	.181*	.090
Protectiveness	-.121	-.097	-.077	.164*	.147*
Curiosity	-.108	-.048	-.029	-.013	-.141
Pugnacity	.136	.186	.289*	.169 *	.075
Play Phantasy	-.143	-.120	-.106	-.018	-.048
Acquisition	.048	-.057	-.021	.045	-.145
Self Sentiment	-.112	-.169	-.189	-.134	-.093
Super Ego	.140	.172	.164	-.141	-.140
Religion	.074	.009	.103	-.123	.083
Patriotism	.387**	.229*	.268*	-.011	-.055

On grades, gains in the 2-3 period are significantly related to high Protectiveness and high Religious sentiment development. The most widespread finding, however, is the positive relation of gains to Acquisitiveness, except in the local school grade situation.

Turing next to the Integrated components in these dynamic structures we observe that Sex, Sensuality and Narcism are significantly negatively related to gain in the later (2-3) period, though the first has some positive relation in the first period. Significant positive gain relations in the second period are also found for Super Ego and Patriotism, and negative relations for Self Sentiment. As with the unintegrated, the Acquisitiveness ergic tension is positively related across the board, but especially in the second period. Grades are again different from standardized tests, showing greatest gains with high Constructiveness, Protectiveness and Pugnacity.

What is common, therefore, to the Integrated and Unintegrated component measures in the negative relation of Narcism to gain (in the second period), the positive relation of Acquisitiveness to gain, and the positive relation of Protectiveness to gain in terms of grades.

In the complexities of relations of individual ergs and sentiments, which we shall discuss later, there is some risk of overlooking general conclusions. The first of these is that, unlike the ability and personality structures, the relations of dynamic levels are as frequently significant (possibly more so) with changes in achievement as with absolute achievement. This is entirely consistent with the observation that motivation levels (see Table 12) are subject to relatively strong function fluctuation. Why should we expect the achievement representing the accumulated result of years of motivated application to correlate with the motivation level which happens to exist at the end of the period? On the other hand, it is reasonable to expect that the motivation strength this year will correlate significantly with the gain this year.

A second general observation here is that the motivation relations in the second year often appear distinctly different from those in the first. These differences are not of a kind to be wholely accounted for by the error and homeostatic effects, but suggest rather that something is happening at the turn of adolescence which makes the relation of motivation to school different in the 9th grade (15 years) from what it was in the 7th (13 years)--or at 14 relative to 12 years of age if we project back to where the motivation was having its effect.

A third general observation is that, as Sweney in particular has argued (1962), the unintegrated component in motivation behaves in general very differently from the integrated component.

Chapter 5

The Relation of Changes in Personality and Motivation To Changes in Achievement

1. The Problem of Unreliability of Difference Scores

In this first exploratory study the necessary aim of covering a broad field of ability, personality and motivation has necessarily conflicted with the usual aim of obtaining high reliability for the individual measures. For even with the demands on school time for testing which we made no one of our 48 conceptually distinct measures could have more than a few minutes or hope to reach any level of reliability customary in routine practical measures. We believe the compromise we made has justified itself in the broad range of hypotheses with good perspective which this study has generated. But since difference scores are notoriously of low reliability, it is in this chapter, where we correlate differences in the predictors with differences in the criteria scores, that we pay most heavily by conclusions of individually lower probability, for the breadth of the relations included in the conclusions.

The usual formula for calculating the reliability of a difference score from the reliability of the component before and after scores is given by Guilford (1950),

$$r = \frac{r_{yy} + r_{xx} - 2r_{xy}}{2(1 - r_{xy})} ,$$

where r_{yy} and r_{xx}, the reliabilities of the two measures involved, are assumed to be the same on the two occasions. For these we have used the reliability coefficients of the HSPQ personality factors as given in the Handbook (Cattell and Beloff, 1960), while r_{xy} is the correlation between the two occasions. This formula implies that if the correlation between the two occasions is higher than the reliabilities of the measures themselves then the reliability of the derived change score will be zero or negative. The reliabilities, correlations between occasions, and reliabilities of change scores are presented in Table 17.

Table 17

Reliabilities of Difference Scores for Personality Factor Change From Occasion 2 to Occasion 3

Factors	Reliabilities Single Scales	Correlations Between Occasions Form A	Correlations Between Occasions Form B	Reliabilities Of Differences Form A	Reliabilities Of Differences Form B
A	.58	.548	.259	.218	.462
B	.60	.247	.463	.341	.393
C	.62	.491	.253	.146	.555
D	.64	.524	.242	.448	.347
E	.56	.471	.168	.352	.320
F	.52	.535	.032	.560	.090
G	.55	.442	.193	.440	.196
H	.67	.428	.423	.429	.422
I	.66	.815	.344	.562	.223
J	.53	.490	.178	.300	.328
O	.56	.546	.180	.594	-.083
Q_2	.54	.279	.293	.388	.244
Q_3	.58	.223	.459	.410	.288
Q_4	.64	.382	.417	.377	.427

The reliabilities of the change in performance scores can be gauged in the same way giving reliabilities of .810, .047 and .816 for the Metropolitan Achievement Test differences for the first to second, second to third, and first to third occasions respectively. (The reliability of the second difference score fails because the correlation between the two occasions--.916--is almost equal to the reliability--.920.) The corresponding difference reliability (second to third) for the California is .753. These figures indicate why most of the (2-3) interval correlations with the Metropolitan test in Table 16a are so small, and where we need to be most cautious in conclusions from the present data.

The corresponding reliabilities for differences in the ergic tension and sentiment motivation strengths are given in Table 18. (The values from which they are derived are in Table 12 above.)

Table 18

Reliabilities of Difference Scores

On Motivation Strengths

Factor	Unintegrated	Integrated
Assertion	.09	.33
Sensuality	.01	.23
Sex	.08	.02
Gregariousness	-.01	.17
Narcism	-.01	.10
Constructiveness	-.10	.43
Protectiveness	.36	.30
Curiosity	.11	.33
Pugnacity	-.25	-.02
Play Phantasy	-.25	.17
Acquisition	.02	.15
Self Sentiment	.21	.00
Super Ego	.07	.22
Religion	.09	.18
Patriotism	-.20	.19

Here it is evident that the reliabilities of differences on the *unintegrated* component are virtually zero, though the reliabilities of the *integrated* are with four exceptions significant.

2. Relations of Personality Change to Achievement Change

We have felt it desirable to present all the correlations that can be worked out, for whatever help they may be to the researcher looking for the movement of straws in the wind when forming hypotheses in this area. Nevertheless, for purposes of firm conclusions, much of Table 19 is to be discarded. For it largely deals either with a regressed difference score which we believe to be misleading as a difference score, or with a Metropolitan achievement difference of negligible reliability.

However, this still leaves periods 1-2 and 1-3 as reliable, and for raw or rank difference scores. In these we venture to call attention to (a) the consistent relation of increase on factor H to increase in achievement, as measured in the raw scores, and found for both A and B forms; (b) the increase of ego strength, C, factor with increasing achievement; (c) the negative relation of Q_3 increases; (d) the negative relation of I factor increases (to achievement increases). Additionally, one might note the indications significant in only one form that (e) increase in J and in Q_2 are related to increase in achievement, and (f) decrease in achievement is associated with increasing ergic tension, Q_4.

From Table 20 we conclude that there is an increase of affectothymia (A), of surgency (F), of parmia (H), and of lack of self sufficiency (Q_2-), with increase in achievement. These are mentioned together (and one may add E and J- at a lower level) because they demarcate the extraversion factor. Since the components are thus significantly related one may definitely conclude that if we scored

Table 19

Personality Change Related to Change On The Metropolitan Achievement Test

HSPQ, Form A

Factor	Raw Differences (1-2) (64)	(2-3) (66)	Regressed Differences (1-2) (52)	(2-3) (49)	(1-3) (49)	Rank Differences (1-2) (65)	(2-3) (68)
A	-.046	.114	.123	-.056	-.192	-.147	.254*
B	-.116	-.090	-.018	-.049	-.097	.137	.005
C	.315**	-.282*	-.001	.247*	.378**	.240*	-.151
D	-.119	-.151	-.116	-.030	.095	.138	-.087
E	.093	-.038	.148	.068	-.079	.033	.054
F	-.148	-.012	-.006	-.128	-.166	.041	-.028
G	.024	.150	-.013	-.023	-.026	-.073	.245*
H	.172	-.036	.013	.147	.225	-.023	.237*
I	-.085	-.087	.118	.136	.034	-.195	.158
J	.162	.003	.204	.218	.100	.168	.072
O	-.169	.055	.135	.029	-.131	-.156	-.004
Q_2	.011	.027	-.010	.041	.149	.131	-.175
Q_3	-.194	-.015	.037	-.029	-.069	-.111	.162
Q_4	-.065	.195	.047	.049	.032	.053	.136
HSPQ, Form B							
A	.119	.082	.180	.214	.101	-.044	-.024
B	-.023	.204*	-.015	.049	.029	.016	.006
C	.194	.054	.074	.095	.087	.094	.017
D	-.096	.094	.056	-.115	-.242*	-.028	.026
E	.085	.023	.094	.001	-.144	-.110	.076
F	-.081	-.014	.239*	.051	-.187	-.133	.041
G	-.173	.126	-.018	-.109	-.164	-.222*	.165
H	.213*	-.039	.032	.204	.266*	.117	-.135
I	-.072	.247*	-.005	-.150	-.245*	-.173	.172
J	.028	.121	-.022	-.044	-.005	-.086	.072
O	-.047	.257*	-.062	-.134	-.154	.062	-.023
Q_2	.108	.200	.056	.144	.197	.078	.126
Q_3	-.074	.311	.039	-.125	-.202	-.201	.219*
Q_4	-.179	.017	.040	-.112	-.248*	-.277*	.073

Table 20

Personality Change Related to Change On The California Achievement Test and Grade Change

	HSPQ Form A	HSPQ Form B				
Factor	Trend In Grade (2-3)	Raw (2-3) (65)	Regressed (2-3) (58)	Rank (2-3) (65)	Grade Change (2-3) (145)	Trend In Grade (2-3) (147)
A	-.064	.253*	.165	.157	.078	-.085
B	.219*	.128	.193	.175	-.066	.058
C	-.204*	-.123	-.099	-.129	.042	.078
D	.041	-.053	-.185	-.216*	-.088	-.062
E	-.020	-.067	-.041	-.037	-.025	-.085
F	.221*	.121	.129	.190	.016	-.014
G	-.283**	.176	.130	.187	.015	.006
H	-.237**	.129	.051	.049	-.107	-.088
I	.082	-.182	-.124	-.107	-.030	.032
J	-.216*	-.067	-.071	-.026	.082	-.050
O	-.026	-.099	-.021	-.097	-.069	.121
Q_2	-.139	-.173	-.057	.025	-.002	-.100
Q_3	-.236**	-.112	-.113	-.084	-.053	-.040
Q_4	.307**	-.101	-.270*	-.246*	.008	.144

for the second order factor we should find increase of extraversion significantly related to increase in achievement, but this would be true of standard achievement, not grade achievement. Since there is little feedback to the pupil on his standard achievement score it seems reasonable to call the increase in extraversion the cause of increase in achievement, not vice versa.

Additionally, we note (a) an increase of intelligence with increase in achievement, which occurs for both the grades and the standardized test; (b) an increase of achievement with increased super ego strength, G, which however, is absent or reversed with respect to grade trend; (c) an increase of achievement with reduced ego strength, C, which is present both for the objective test and for grades. In connection with this last one cannot help noticing again a consistency across a whole second order factor, namely, in that C-, H-, O, Q_3- and Q_4 move together, supporting the hypotheses that an increase in anxiety is accompanied by a positive trend in grades. Very curiously this relation is in the opposite direction for the objective achievement test, except for ego strength, C, and self sentiment, Q_3, in that we find D-, H-, O-, and Q_4-.

Some general resemblance is to be noted between these change-cum-change relations and the relations of absolute personality level to achievement change as recorded in the previous chapter.

3. Dynamic Structure Motivation Level Change
And Achievement Change

The reliabilities of the motivation strength changes measures have been given in Table 18. Although they are significantly reliable only for the integrated components we have presented the values also for the unintegrated.

Table 21

Correlations of Motivation Strength Changes with Changes in Achievement

Metropolitan Test

	Unintegrated		Integrated	
	Raw Diffs. (1-2)	Rank Diffs. (1-2)	Raw Diffs.	Rank Diffs.
Assertiveness	-.23*	-.16	-.15	-.10
Sensuality	-.13	.06	-.25*	-.28*
Sex	-.15	-.08	-.10	-.18
Gregariousness	-.16	-.28*	-.30*	-.20
Narcism	-.02	-.06	.04	-.02
Constructiveness	-.15	-.23*	.05	.08
Protectiveness	.11	.06	-.02	.10
Curiosity	-.02	.16	.07	.02
Pugnacity	-.04	.04	-.27*	-.22*
Play Phantasy	-.04	.08	.08	.03
Acquisition	.41**	.23*	-.13	-.16
Self Sentiment	.20	.00	-.21	-.18
Super Ego	.14	.01	.05	.09
Religion	.12	.18	.10	.15
Patriotism	.20	.17	-.10	-.18

California Achievement Test and Grades

Unintegrated

	Raw Diffs.	Regressed Diffs.	Rank Diffs.	Trend In Grades	One Year Grade Change
Assertiveness	-.074	-.089	-.132	.051	.139
Sensuality	-.216*	-.161	-.293**	-.113	-.066
Sex	.002	-.037	.106	-.021	-.038
Gregariousness	-.144	-.235*	-.147	.071	.091
Narcism	-.184	-.024	-.143	-.086	.087
Constructiveness	.085	.226*	.088	.035	.152
Protectiveness	-.054	-.085	-.173	.048	-.075
Curiosity	.079	.044	.022	-.045	-.104
Pugnacity	.203*	.185	.180	-.030	.068
Play Phantasy	.061	-.008	-.019	.005	-.021
Acquisition	.180	.270*	.244*	.034	.004
Self Sentiment	.060	-.085	.069	-.018	.032
Super Ego	-.066	-.079	.020	.009	-.023
Religion	-.065	-.044	-.052	-.085	-.013
Patriotism	-.043	.027	-.021	-.032	.140

Table 21 Continued

Integrated

	Raw Diffs.	Regressed Diffs.	Rank Diffs.	Trend In Grades	One Year Grade Change
Assertiveness	-.026	-.005	-.059	-.154	-.210
Sensuality	-.028	-.044	-.136	-.217*	-.227*
Sex	-.151	-.214	-.091	.093	.113
Gregariousness	-.248*	-.293*	-.195	-.062	.053
Narcism	.085	.097	.103	.131	.032
Constructiveness	-.062	.024	-.119	-.064	-.102
Protectiveness	.123	.101	.066	.096	-.012
Curiosity	-.067	.010	.055	.035	.103
Pugnacity	.097	.182	.244*	.029	-.092
Play Phantasy	-.050	-.194	-.067	-.001	-.040
Acquisition	.262*	.238*	.217*	.114	-.160
Self Sentiment	-.161	-.218	-.180	-.055	.045
Super Ego	.002	.094	-.054	-.121	.052
Religion	.027	.062	.084	-.069	-.016
Patriotism	.226*	.121	.201	.101	.011

In the unintegrated we again see the positive relation to gain noted before. In the California test data this is confirmed, and we note also a strong negative relation of sensuality. In the integrated component, somewhat similarly to the absolute level correlations, acquisitiveness again plays a role while the constructive erg and religious sentiment show positive correlations with improvement. Inversely related to improvement are sensuality, sex, gregariousness, self assertion and pugnacity. The interpretation of similar results in the past has been that these powerful drive elements act as distractors from good achievement during this period of adolescence, while some of the more culturally determined factors--the sentiments--tend on the whole to gain satisfaction from these socially approved behaviors.

Regardless of interpretation, it is evident that the dynamic traits seem more closely connected with the achievement change scores than the absolute achievement scores, as discussed earlier.

Chapter 6

The Exploratory Study of Intra-Familial Attitude Measurement

1. The Plan

As mentioned earlier the previous work on intra-familial attitudes has been wholely restricted to direct rating scales either to be checked by Interviewers or Interviewees, e.g., Fels Parent Behaviour Rating Scale (Baldwin, Kalborn and Breeze, 1945), Fels Child Behaviour Rating Scale (Richards and Simons, 1941), the Interview Rating Scales of Sears, Maccoby and Levin (1957) and Bandura and Walters (1959). Self Scales include the Porter Parental Acceptance Scales, and more widely used the Parental Attitude Research Instrument, PARI (Schaeffer and Bell, 1958). No attempts have been made to measure intra-family attitudes by objective, indirect and non-fakable methods, with batteries of tests that measure the most important factors in a way that covers all relationships within the family and in forms suitable for all members of the family.

The present research aimed to investigate the possibilities of measuring intra-family attitudes in terms of the constituent drive factors, and the person to whom they are directed, by objective methods. First, an attempt was to measure a series of attitudes falling into hypothesized interpersonal attitude factors. Each attitude was measured by four devices; parallel batteries were devised for parents and children. It was planned eventually to validate the measures both internally, against ergic and sentiment factors and externally against social worker ratings.

2. The Measuring Devices

The following best four devices from previous research were set up with respect to the attitudes listed in Table 22.

(1) Autism Test: In this test subjects were asked a series of questions with five choice answers; they were tested to estimate the frequency or extent of some phenomenon related to a particular intra-family attitude. Their answers were weighted according to the direction they took. The test measures the unintegrated, less organized, more hedonic aspect of interpersonal attitudes. An example might be as follows:
"What percentage of children sometimes tease their younger brother?"
94%, 75%, 55%, 35%, 25%
The percentage chosen is regarded as indicating the strength of the individuals 'interest' in teasing their younger sibling, as measured from the point of view of the unintegrated hedonic aspect of motivation.

(2) Paired Words: In this test the subject is given a stimulus word followed by two association words. Each association word is regarded on a priori grounds as representing a particular interpersonal attitude. In this way each attitude can be paired with all other attitudes and measures obtained of the frequency with which words relevant to each attitude are chosen. This test, is self-ipsatizing like all 'preference tests' that pit each choice against all other choices, and measures the integrated aspect of motivation.

(3) Learning Language: This test is an association learning task in which the subject learns to associate phrases describing interpersonal attitudes with nonsence syllables. The hypothesis underlying the test is that the subject will more readily learn associations for those attitudes in which he is involved or interested. This device measures integrated motivation.

(4) Memory: The subject is permitted a short period of time to learn a list of phrases relevant to the interpersonal attitudes. He is then shown a larger list and has to state which of these were in the first list. The assumption of the test is that the subject will more readily remember phrases relevant to areas in which he has higher "interest"; the test is a measure of unintegrated motivation.

These four devices were used to measure 38 attitudes, each attitude is relevant to a particular hypothesized dynamic factor (e.g., assertiveness, aggressiveness, etc.) and the person involved (i.e., either Father, Mother, or child). Two batteries of similar devices and essentially similar content were made up to test the dynamics of a child's relationship to his father, mother, and siblings, and of the parents to one another and to their children. The first stage of the research was the application of this battery to children only. The second stage involved the application of refined versions of the test to children and similar forms to their parents. The attitudes measured are set out in Table 22 as follows:

Table 22

Attitudes Measured in Child and Parent Studies
of Intra-Family Attitudes

A. Child to Sibling Relationship

Pugnacity:

1. I want to fight and argue with my siblings.
2. I want to tease and plague my brothers and sisters.

Gregariousness:

3. I want to participate in outdoor activities with my siblings.
4. I want to play at home with my brothers and sisters.

Assertion:

5. I want to do things better than my siblings do them.
6. I want my siblings to do things to make me proud of them.

Protective:

7. I want to fight for my brother or sister.
8. I want to help my siblings with their school work.

Fear:

9. I want to avoid getting hurt by my brothers or sisters.
10. I want to have help from siblings in avoiding danger.

Appeal:

11. I want to turn to my brothers and sisters for help.
12. I want my brothers and sisters to look after me.

B. Child to Father Relationship

Pugnacity:

13. I want to 'whip' my father.
14. I want to slam doors and throw tantrums to show my father that I am angry.

Appeal:

15. I want my father to always control me.
16. I want to obey my father.

Assertion:

17. I want to bring home a good report card.
18. I want my father to be important in our community.

Acquisitive:

19. I want my father to give me lots of presents.
20. I want to receive a big allowance from my father.

Gregariousness:

21. I want to go fishing, hunting or on other outings with father.
22. I want to listen to father's jokes and stories.

Fear:

23. I want my father to protect me from all kinds of danger.
24. I want to avoid being severely punished by my father.
25. I want father to protect me from mother's wrath.

C. Child to Mother Relationship

Pugnacity:

26. I want to talk back to mother.
27. I want to run away from home and reject mother.

Sensuality:

28. I want mother to feed me well.
29. I want to be hugged and kissed by my mother.

Narcissism:

30. I want mother to listen to the smart things I have to say.
31. I want Mother to help me to dress well to please her and others.

Curiosity:

32. I want mother to answer my questions about science and the world.
33. I want mother to teach me how to do things.

Gregariousness:

34. I want to spend time with mother.
35. I want mother to help me plan parties at home.

Fear:

36. I want mother to protect me from sickness and unknown situations.
37. I want to be safe from mother's anger.
38. I want mother to protect me from father's anger.

D. Parent to Child Relationship

Pugnacity-Aggression:

39. I want to punish my child more severely for irritating behaviour.
40. I want my child to go away and stop annoying me.

Assertion:

41. I want my child to be admired and do well like his parents.
42. I want my child to admire me and take me as a model.

Protectiveness:

43. I want my child to be happy and have the best of everything.
44. I want to heed my child's feelings and give him good things.

Sensuality-Sex:

45. I want to hug, kiss, fondle and romp with my child.
46. I like to watch my child and have beautiful pictures made of him.

Gregariousness:

47. I want to go out to places with my child.
48. I want my child to talk with me, sharing hobbies and roles.

Fear (Overprotection):

49. I went my child to be safe and watched over, not having accidents, and illnesses.
50. I want my child to keep me from loneliness and insecurity in my old age.

E. Parent to Parent Relationship ("Inter-Spouse")

Sex:

51. I want to have the most satisfactory sex life with my spouse.
52. I want to have a continuing playful courtship with my spouse.

Assertion:

53. I want people to say what a fine spouse I have chosen.
54. I want my spouse to admire the things I do and respect me.

Protectiveness (Tenderness):

55. I want to protect my spouse from unpleasant things.
56. I want to anticipate my spouse's fondest wishes, with presents, services.

Gregariousness:

57. I want my spouse to join me in helping us have a lot of friends.
58. I want my spouse to share my thoughts, feelings, tastes, and activities.

Fear:

59. I want to feel secure in the faithfulness of my spouse.
60. I want my spouse to stand with me against all sources of danger.

Hostility:

61. I feel I should punish my spouse for various irritating shortcomings and neglects.
62. I feel the need to withhold my affection and show my resentment at times.

These attitudes were measured on a preliminary sample of 191 children of between 12 and 15 years of age (91 boys and 100 girls), from a junior high school in Illinois. The total testing time was 6 hours in two sessions.

3. Analysis of Results

The results were analyzed only for the children, measured on the attitudes (Table 22) to mother, father and a sib. First the score matrix was ipsatized, that is each subject's normalized scores were brought to the same mean and standard deviation; thus the score taken for each attitude was the difference between the raw score and the mean score over all attitudes for that subject divided by the standard deviation for that subject. The results were then factorized by the principle axes method to estimate the number of factors to take out by the Kaiser criterion, as well as by Cattell's scree test. This was done separately for the 38 variables (see Table 22) measured by the unintegrated devices--Autism and Memory--and for the same 38 variables measured by the integrated devices--the scores from adding paired words and learning. The number of factors appeared by these criteria to be about the same in each, namely nine or ten.

From the beginning we experienced quite unusual difficulty in rotating these factors to simple structure. It was not so much that a tolerably good hyperplane count could not be obtained, for after 10 complete cycles of rotation after the oblimax position we had achieved a hyperplane count of 68%. The difficulty arose from the apparent existence of alternative simple structures.

At one time, in the unintegrated measurement factor matrix, reasonably clearly identifiable factors of pugnacity, gregariousness and fear, related respectively to father and to mother, appeared, and assertion appeared as two factors, one to sibling and one to father. Our expectation had been that we would obtain six distinct ergic factors, on the one hand, and three distinct sentiment factors, on the other, along with a possible general instrument factor (Cattell and Digman, 1964).

After 20 further over-all rotations, which required an additional three months, and exhausted the budgetted sum for computer hours, we were reluctantly compelled to recognize that we had a problem which could not be solved without a special study extending beyond the present grant. It would seem desirable to design an experiment in which (a) the same family members are coupled with a different number of ergic (drive) satisfactions, and (b) a different set of objective measurement devices. Only by comparisons observing the different simple structures emerging with such changes can one hope to determine the proper factor resolution. The application of objective devices, and vector concepts of attitudes, to family dynamics, is a very worthwhile undertaking, as is witnessed by the emergence of sufficient structure, despite the existence of alternative structures, to permit the drives and sentiment objects to be recognized. But no solution seems possible without devoting to this one topic resources of the magnitude assigned to our whole research.

Chapter 7

Summary and Discussion

1. Replication of Findings on "Static" Prediction

Two groups of children, one of about 80 beginning in seventh grade and continuing through ninth, and one of about 150, in eighth grade continuing through ninth, were made the subjects for successive annual cross sectional studies (three in the first and two in the second group) permitting both "static", absolute and developmental analyses.

They were tested on (1) school achievement, by both (a) standardized multiple choice tests, and (b) school class grades, (2) intelligence, using a traditional intelligence test for "crystallized general ability", (3) personality factors, by the High School Personality Questionnaire, (4) motivation level on dynamic structure factors, and (5) family attitudes.

The first analysis was a replication of the first pioneer research on prediction in high school from personality and motivation factors. The correlations in this "static" prediction from absolute levels on the traits agreed well with those of the first study, except that the correlations of the dynamic factors with the criterion were slightly lower. The super ego and self sentiment factors had significant positive relations as before. Among dynamic factors the separate analysis for integrated and unintegrated components, not previously made, revealed differences between them of some magnitude. In the integrated, sensuality and gregariousness were negatively related to achievement, while in the unintegrated gregariousness was positively related and protectiveness negatively related.

By combining intelligence, personality and motivation variables a multiple correlation with the school grades criterion of 0.81 was obtained, which, corrected for shrinkage, becomes 0.65. With the standardized, multiple choice achievement test (Metropolitan and Californian), the R reaches 0.85 (corrected for shrinkage to 0.73). These are very close to the magnitudes suggested by the previous research The reliabilites of the various measures show the highest figures for the intelligence test and the criterion (though school grades and standard achievement tests agree only at r = .6), closely followed by the personality tests, and then at some distance by the motivation measures.

The psychological meaning of these correlations needs little discussion, agreeing with the role of self sentiment and super ego development in long term goal striving, and the interrupting effect of dissatisfied sensual and other drives.

2. The Changeability of Children's Traits

A second analysis was made to evaluate the normal degree of fluctuation and change in traits and performances over a year period.

Considering change first as trend it is demonstrated that several significant trends in personality exist over the 13-15 age range, notably a rise in intelligence (B factor), in super ego strength (G factor), in parmia (H factor) and in self sentiment (Q_3). In girls but not in boys there is a significant increase in ego strength, C.

In dynamic structure development the effects are different in integrated and unintegrated components. Sex erg shows a significant increase for boys, in the unintegrated component, but not for girls. Sensuality (unintegrated) drops significantly for both. Patriotic sentiment tends to fall, as also does protectiveness. The self sentiment strength increases powerfully. These changes can in part be brought under the notion of increased individuation.

Fluctuation over a year in personality traits is larger than has been found in abilities and aptitudes. The evaluation of fluctuation in dynamic traits is more difficult because of the much lower reliability (dependability) of the pioneer objective dynamic trait measurement (in the PMT). If r_d is the test dependability coefficient and r_s the one year stability coefficient with σ^2_e as test error variance and σ^2_f as trait fluctuation variance, then:

$$\sigma^2_f + \sigma^2_e = 1 - r_s \text{ , and } \sigma^2_e = 1 - r_d$$

Consequently, in standard scores,

$$\sigma^2_f = r_d - r_s$$

This value derived from Tables 10 and 12 by averaging is:

Personality Traits	$\sigma^2 = .13$
Dynamic Traits (Unintegrated)	$\sigma^2 = .04$*
Dynamic Traits (Integrated)	$\sigma^2 = .15$

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* This value can only be roughly determined from the extreme values present in the reliabilities, and is probably a marked underestimate.

The implication is that over a year there is an even chance of a personality trait changing by a standard score of within ±.24, an unintegrated motivation trait within a standard score of ±.16 and an integrated dynamic trait by within a standard score of ±.26. Here we are speaking of the trait change itself not of changes in measurement of the trait. Approximately this means that the trait will change within a year with an even chance of being within or beyond half a sten of the original.

3. Relation of Change in School Achievement To Traits At the Beginning of the Year

At this age period the gain in achievement is slightly greater for girls than boys. Although intelligence (measured as crystallized ability, by the traditional culture-contaminated tests) correlates about 0.58 with the absolute level of achievement it has centrally a zero correlation with gain in achievement. We interpret this hypothetically as the combination of (a) a slight positive correlation with fluid general intelligence if truly measured by a culture fair intelligence test, and (b) a slight negative correlation with present achievement level due to the homeostatic effect, discussed below.

Among personality source traits, achievement gain over the year is significantly positively related to super ego strength, G, to parmia, H, and negatively to self sufficiency, Q_2. There are indications of positive connections with level of surgency, F, and strength of self sentiment, Q_3. However, one finds what appears to be a systematic difference between the personality factors which foretell increases respectively on an objective, multiple choice, examination designed outside the particular school system and the grades assigned by the class teacher in that school system. This difference is scarcely due to subject areas, which are nominally practically the same, but it could be due to (a) the difference between learning precisely the content given in class, as opposed to learning more widely, and (b) doing homework and classwork well as opposed to doing well only in examinations, and (c) a subjective element in the class teacher's grading due to confounding reaction to the child's personality with reaction to what is actually done in the classroom examinations. The main difference can be summarized at the second-order personality factor level by pointing out that those who succeed in class are(1) more introvert, and (2) more anxious (since these are both components in neuroticism (Cattell and Scheier, 1961) one might make a further, but naturally more loose generalization that the less neurotic succeeds, relatively, in the external examination). It fits hypotheses (a) above that Howard (In press) has recently shown with the 16 P.F. that individuals higher on O and Q4 (precisely the anxiety components here) stick more to "trusted and tried" paths, and thus would do relatively well in the paternalistic classroom environment.

In the area of motivation measurement, where reliabilities are lower, the results are less clear, but there are strong indications of a change of role of motives at this juncture, such that what helps in the pre-adolescent 13 year old year may even hinder in the 14th and 15th years. For example, narcism, super ego and low pugnacity are positively correlated to gain in the second. What seems common to both periods and to integrated and unintegrated measures is a significant positive relation of gain to strength of the Acquisitive drive. Generally sex, sensuality and narcism drives are negatively related to achievement gain. This, it will be noted, is a very different more complex and clinically-related description of achievement psychology from that given, tantologically, in McClelland's (1953) "achievement need" hypotheses. In general, the relation of dynamic trait measurements (relative to ability and personality measurements) is higher with the gain scores than the absolute scores, consistent with the above findings of changeability in the dynamic traits, whence one must take their relations more immediately.

4. The Relation of Changes In Achievement To Changes in Personality and Motivation

Since change scores are inevitably, psychometrically, less reliable than absolute scores, we recognize that in relating change scores to change scores our results are likely to be only of exploratory interest. Their aim is to indicate to those who follow the hypotheses about relationships which can be concentrated upon in the area stated with lengthened, more reliable measures.

Actually the reliability of the difference scores on the personality tests, while not high, were significant and satisfactory. They were of the same general level as for the intelligence test (B factor). Those for the dynamic structure measures, on the other hand, were low, and, except for particular dynamic attachments, tolerable only in the series of integrated component measurements. Consequently the correlations with school achievement gain were also low, when uncorrected for attenuation.

The actual associations resemble those found in the prediction from absolute levels, the biggest association being that between the achievement gain score and the increase in acquisitiveness at the unintegrated level. Increases in pugnacity and sensuality, and, at the level of indications, in sex, self assertion and gregariousness, are negatively related to increments in achievement.

The reader must study for himself (Cattell, 1957; Cattell, Radcliffe and Sweney, 1963; Hall and Lindzey, 1957) the meaning of the dynamic measures here used. They are essentially what their names indicate--ergic drive patterns found by objective methods, in man--apparently directed to goals of sex, destructiveness (pugnacity), general sensual satisfaction, friendly social interaction (gregariousness), etc. Although the direction of causal action cannot at the moment be read into our correlations, but awaits further sequential experiment, one can hypothesize with reasonable probability a causal action in both directions. For example, high sex and gregarious ergs could obviously operate by distracting from school work. On the other hand, a rising pugnacity could be a consequence rather than a cause of failure and frustration in the school situation. The curious and unexpectedly strong role of the acquisitive erg can only be explained by more research on it. All that can be said at present is that we find (Sweney and Cattell, 1962) among children a factor loading a set of attitude-interests which appear to have in common only the tendency to acquire and collect and cherish things--of all kinds. This apparently plays a larger role in collecting good grades than does self assertiveness (one of the two main discoverable unitary components--the self sentiment is the other--in the loose notion of "need for achievement").

5. The Problem of Measuring Inter-Familial Attitudes

Instead of being able to proceed to evaluate the predictions of achievement obtainable from measures outside the child, namely, from the family environment, we found ourselves trapped in methodological and instrument difficulties needing to be faced in developping this measurement.

Experienced researchers will probably readily concede--as a kind reaction to our disappointment--that the pioneer analysis by objective motivation measurement devices of the family attitude structure, and the development of practicable instruments in the light of such findings is itself a research needing support beyond that allocated to our total research. We can claim only to have (a) demonstrated that objective devices, e.g., word association, autism, etc., are practicable for measuring children's attitudes to parents and sibs, (b) set up a design which pursued with sufficient resources, appears to be on the right lines for separating ergic components, sentiments (to father, mother, sib) and instrument factors, (c) demonstrated that certain rotations will yield *some* of these hypothesized structures.

However, in terms of factor structure, the diversity of components in the system evidently calls for unusually careful and protracted rotational procedures, and we came to the end of time and money before a complete resolution could be gained. Consequently we can offer no evidence on criterion prediction from family attitudes.

6. Some Reflections On Methods and Models In Relation to Conclusions

Models can be produced by the dozen; the useful contribution in the domain of models is to present a model shown to have a sufficiently good fit to the scientific facts to be worth further employment and refinement. It is not our intention here to survey possible models in change analysis, but only to comment constructively on a few central issues.

In terms of the correlation magnitudes and significances to which teachers working in the field of "absolute" measures are accustomed ours are undoubtedly going to be regarded as meager. Some of this reduction is clearly due to the lower reliability of difference measures which, incidentally, we have left those who desire it to correct for by correcting r's for attentuation, to try various specific hypotheses. Even a widely used achievement test, on one of our samples and one particular interval, proved to have a virtually zero reliability for its difference (change) scores. So the low reliability of personality and motivation change scores cannot, without prejudice, be written off as due to the novelty of the tests.

Elimination of this low reliability is not really possible by any statistical tricks. It can come only by increasing the length of tests and improving the scaling. Of the three methods of scoring gains which we tried--raw scores, partialling out of absolute level, and rank differences--we believe that the first and simplest is the most correct, provided some attention is given to scaling. The second "regressed" method, which we have written above as $S = B - rA$, though useful for some purposes indicated by Lord (1952), has the major weakness of requiring a theoretical model which is almost certainly untrue, namely, one in which the increment is independent of the absolute level. For no growth in a tree or learning in a human being fits this model.

Let us suppose, for a moment, a typical growth phase in which the larger child tends absolutely to grow more in a year. It is of interest to know what this larger growth increment relates to, e.g., more changes of clothes, regardless of how it comes about. If we relate it to food intake, then it may be that this is determined partly by growth and partly by sheer size, but this is a matter to discover later by examining the effect of partialling out sheer size from both (not from one variable only, as in the "part correlation" (Manning & DuBois, 1962) implicit in Lord's treatment).

As between the raw score (properly scaled) and the rank difference, the former is slightly to be preferred, for obvious reasons, if we assume a normal distribution, and the r's obtained here reach significance slightly more frequently for the raw score. All three methods give results mainly of the same nature, as far as empirical conclusions are concerned. However, significant differences sometimes occur, as in the relation of intelligence level to increments in attainment in Table 15. Here the less complete elimination of the initial achievement level in the regressed formula ($B - rA$, instead of $B - A$) results in the former giving a zero correlation where the latter gives a significant negative one. This is presumably due to present achievement being substantially predicted by present intelligence, and to present achievement being negatively related to the increment measure in the second but not the first form. If it is true--in some true scaling sense--that this negative relation of increment to absolute exists, we should not, however, mask it.

In this connection we have recognized that part of such a negative correlation may be due to error of measurement, added to the first occasion true score and subtracted from the true increment score, but we have also argued that part is due to a larger contribution from what we have broadly called homeostasis. By this we mean a real, not artefactual, tendency for an individual highly deviant at some stage to become less deviant at the next. It may not hold for all psychological conditions (in some schizophrenic stages one hypothesizes a spiral in which deviation causes more deviation). But in general a "tour de force" is due to a rare concatenation of influences which cannot be readily repeated, and the individual is likely to move nearer to the average. This is our hypotheses to explain a slight but perceptible overall trend in our figures for relations to the criterion in the second period to be reversed relative to those in the first. For example, (Table 15, columns 6 and 7), high surgency is connected with achievement increment in the first period and decrement in the second; high narcism with increment in the first and decrement in the second (Table 16a, columns 1 and 2), and high increment in ego strength is associated with increment in achievement in period 1 and decrement in period 2 (Table 19). It requires only that the personality trend continue steadily and the complex criterion resultant behave "homeostatically" from year to year to produce such results.

On the other hand specific psychological explanations can readily be offered for such results, provided we accept, as we almost certainly must, two-way causal connections, ie., feedback. Lack of frustration increases surgency, F, as we know, but surgency may in turn detract from effort and thus lower performance. A similar explanation is possible for the other two instances above. For example, ego strength is apparently increased by successful coping with trauma (Cattell and Rickels, 1965), but it may then reduce anxiety, and, as we have seen, at least for grades, lowered anxiety is associated with lowered achievement.

The findings above of a change in emphasis in the achievement formula between two successive years must also be discussed from the standpoint of systematic changes with age. One would perhaps hesitate to conclude from such effects with a pair of immediately contiguous years that general trends exist, were it not that (a) these years stand at the crucial turning point of adolescence and (b) psychology offers numerous instances of systematically changing factor loadings and variable correlations with age. In the present instance the major hypotheses to which we are directed for future research are:

(a) That the influence of individual differences in intelligence upon individual differences in achievement increment must have been substantial before the age we studied (to account for the substantial correlation of the absolute levels), but that by 14 to 15 years the correlation has become trivial, and individual differences in personality and motivation have taken over the major role in determining achievement increments. One check on this could be made even with absolute measures alone, in that the loading of intelligence on achievement should increase, and that of personality factors decrease, in cross sections at lower age levels (and conversely for college age levels).

(b) That achievement increments from year to year are relatively strongly determined by motivation factor (dynamic structure tension) levels (at this and later ages) relative to ability and personality measures. The reason why ability and personality traits show larger correlations (even at this age) when absolute, "static" measures of both are involved, is that these stay at relatively steady individual levels (so that the last, current measure is representative of what has operated over previous years) whereas motivation measures characteristically fluctuate more.

These are some general and methodological conclusions, but we believe that for the typical psychologist the greatest interest will arise from the specific connections we have found between achievement and such traits as super ego strength, self sentiment strength, sex erg tension, narcism, etc. No attempt will be made here to spell these out in greater detail, because the specific connections listed above are too numerous for a work of this size, and because the psychologist familiar with these concepts as developed by the last fifteen years of factor analytic investigation (Cattell, 1957; Cattell and Scheier, 1961) will entertain himself by seeing how the properties of these traits account for the criterion connections found.

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